CONSTRUCTION SPECIFICATION

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BENTONITE SEALANT (SD-521)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of applying and mixing bentonite, and compacting bentonite treated soil required by the drawings and specifications.

2. Material

Bentonite shall be free flowing, high swelling, granular sodium bentonite. Bentonite shall be American Colloid Company, Volclay SG-40; Wyo-Ben, Envirogel-10; or equivalent and shall meet the following gradation:

Sieve Size	Percent Passing
10	100
20	60 - 100
200	0 - 20

3. Application, Mixing and Compaction

Slopes to be treated shall be flattened to 3:1 or flatter. Holes shall be filled with on-site compacted material. Loose fill soils shall be compacted.

Bentonite shall be applied to soil that is free of vegetation, trash, roots, frozen material, stones over four inches in diameter or other objectionable material. Bentonite must be thoroughly mixed with each soil layer of the blanket.

Thickness of the finished, mixed and compacted blanket shall be eight inches except as specified on the drawings. The blanket shall be constructed in four inch or thinner lifts with each lift containing a proportionate share of the specified rate of bentonite per square foot of blanket (For Example, add half of the bentonite to each four inch lift of an eight inch thick blanket).

Except as otherwise specified on the drawings, compaction of each layer of the blanket must be to 90 percent of maximum density determined by Standard Proctor Test, ASTM D698.

Each bentonite treated soil layer must be moist, but not wet, prior to compaction. When kneaded in the hand, the mix must form a ball that does not readily separate when struck with a pencil, and will not extrude (as mud) when squeezed tightly.

Except as otherwise specified on the drawings a (minimum) 12-inch thick protective cover layer of soil shall be applied over the bentonite-treated blanket.

CATHODIC PROTECTION (SD-31)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of furnishing and installing all materials necessary to complete the cathodic protection system shown on the drawings.

2. Materials

Anodes shall be commercially cast, prepackaged and the size and type specified. Each anode shall have a full-length metal core with a No. 12 AWG or larger insulated copper lead wire attached.

Zinc anodes shall meet ASTM B418 Type II, and shall be packaged in a backfill of 20 - 50 percent bentonite and 50-80 percent gypsum.

Magnesium anodes shall meet ASTM B843, and shall be packaged in a backfill of approximately 75 percent hydrated gypsum, 20 percent bentonite, and 5 percent sodium sulfate.

Wire for header cables, anode leads, and joint bridging shall be single conductor, stranded, plain annealed copper with a high molecular weight polyethylene insulation. Wire for header cables and anode leads shall be No. 12 AWG copper or larger. Wire for bridging joints shall be No. 6 AWG copper or larger.

Powder Weld Process - The welder and powder charge shall be a size, type, and composition recommended by the manufacturer for permanently fastening copper wire to copper wire, steel, and/or cast iron. The completed weld must be a permanent, low resistance copper connection.

Silver Solder Weld Process - The silver solder process shall be designed for very low voltage electrical connections and shall follow manufacturer's instructions and recommendations.

3. Anode Installation

Anodes shall be placed as shown on the drawings. They shall be buried at least three feet below ground surface in undisturbed (not fill) locations. Magnesium anodes must be located at least 10 feet from the metal being protected.

Anodes must be bedded in fine grain soils such as Unified Classification CL, CH, ML, or MH. In sandy and/or gravely areas, fine grain soils must be imported and used to surround each anode to a thickness of approximately six inches. The packaged anodes and surrounding fine-grained soil must be thoroughly wetted and compacted to the density of the surrounding undisturbed earth.

If the anodes are not located in a wet location, sand and/or gravel backfill shall be used above the anodes and fine-grained fill. Backfill above the anode bed shall be left at least six inches lower than surrounding ground surface and the surrounding area shall be shaped to direct runoff to the anode bed.

4. Anode Attachment

Except as otherwise specified, the header wire from the anode bed shall be attached to the metal being protected by a powder weld process. Damaged coatings on metal being protected shall be repaired using a coating equal to the specified original coating.

Except as otherwise specified, Lead wires from the anodes shall be connected to the header wire by a powder weld, brazed, or silver solder process. The connection shall be made waterproof and tightly wrapped with vinyl plastic electrical tape to a minimum thickness of 24 mils. The connection shall be thoroughly cleaned and dried before wrapping.

3. Test Stations

Test stations shall be installed as specified. All wire connections shall be as specified and shall be electrically insulated.

CLAY LINING (CNMS) (SD-34)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of constructing clay linings to control seepage.

2. General

Except as shown on the drawings, the compacted clay lining must be at least 18 inches thick. Except as otherwise shown on the drawings, clay linings for ponds must cover the pond bottom and interior side slopes of the pond up to design storage elevation.

3. Materials

All fill material shall be obtained from required excavation and borrow areas. The selection, blending, routing, and disposition of materials shall be subject to approval of the NRCS inspector. Material used for the clay lining must be either Unified Class CL or CH or other material meeting seepage requirements. Fill materials must not contain frozen material, ice, snow, rocks larger than four inches diameter, sod, vegetation, or other perishable material.

4. Foundation Preparation

The foundation shall be stripped as specified. Except as otherwise specified, foundation surfaces must be flattened to 1:1 or flatter.

If in-place material **is not** suitable for lining, the material must be excavated to the depth needed to place lining below final design lines and grades. If in-place material **is** suitable for the lining, excavate to the depth needed to permit mixing and compaction of the first layer of the lining.

Areas that are too low after stripping and shaping must be filled to base grade with compacted fill equal to that used in other parts of the project.

After the (above) foundation surface is created, nonfill areas must be loosened to a depth of six inches by scarifying or plowing, and then be compacted. Except as otherwise specified, this compaction shall be to at least 95 percent of Standard Proctor (ASTM D698) optimum density at a moisture content within 2 percent of optimum moisture.

5. Lining Placement

Foundation preparation must be completed prior to lining construction. Liner materials **shall not** be placed on a frozen surface.

Lining fill must be placed in approximately equal thickness, uniform layers that are free of lenses, pockets, streaks, or layers differing substantially from other lining material. After placement, fill materials must be spread and blended by motor grader or similarly effective equipment.

Fill layer thickness shall not exceed six inches for compaction by large machines or four inches for small hand directed power tampers. Placement and compaction methods must prevent damage to structures and allow the structure to assume backfill loads gradually and uniformly. Within 2 feet of any structure, fill layer thickness must not exceed 4 inches and equipment loads must not exceed 400 pounds.

Fill moisture content - Except as otherwise specified, at the time of compaction, lining fill moisture content shall uniformly be within 2 percent of optimum moisture (ASTM D698). Control moisture content by adding water, drying, mixing, or grading as appropriate.

If the top surface of the preceding layer or foundation is not within two percent of optimum moisture at the time additional fill is placed, the surface shall be scarified and moisture added.

Fill compaction - Except as otherwise shown on the drawings, lining fill shall be compacted to at least 95 percent of Standard Proctor Density (ASTM D698).

Compaction of fill adjacent to concrete structures shall not be started for at least the following number of days after placement of the concrete.

Concrete Structure	Days After Concrete Placement
Vertical or near-vertical walls with earth load on one side only	14
Walls backfilled on both sides simultaneously	7
Conduits and spillway risers, cast-in-place (with inside forms in place)	7
Conduits and spillway risers, cast-in-place (forms removed)	14
Conduits, pre-cast, cradled	2
Conduits, pre-cast, bedded	1
Anti-seep Collars and Cantilever Pipe Supports (backfill both sides simultaneously)	3

6. Certification and Testing

Except as otherwise specified, the contractor will be responsible for supplying adequate documentation to the NRCS inspector to certify that compaction requirements have been met. Optimum moisture, maximum density and associated test data must be furnished as described in ASTM D698 with adequate in-place density testing and documentation following ASTM D1556, D2167, or equivalent methods. Liner tests must be random and distributed over the liner bottom and side slopes.

Proctor Curves - At least 1 ASTM D698 moisture and density curve with associated data must be prepared for each type of material used in the lining.

In-place density tests - At least two in-place moisture and density tests are required for each acre of each six-inch thick lift, except that the minimum number of tests is four per lift.

Permeability testing alternative - Where the above tests are not performed and reported, at least one permeability test (ASTM D3385, D5093, or equivalent) on the completed liner must be conducted per acre of liner, except the minimum number of permeability tests is 2. These tests must demonstrate that the pond, when full, will have a seepage rate less than $1X10^{-7}$ cm/sec (1/16 inch/day).

CLEARING (SD-1)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of clearing and disposal of trees, snags, logs, brush, shrubs, stumps, and rubbish from the designated areas.

2. Protection of Existing Vegetation

Trees and other woody vegetation designated to remain undisturbed shall be protected from damage throughout the entire construction period. Vehicles, stockpiled materials, and/or ground disturbance shall not be allowed within the dripline of the vegetation designated to remain in place. The contractor shall repair any damage resulting from the contractor's operations or neglect.

3. Marking

Limits of the areas to be cleared will be marked by stakes, flags, tree markings, or other suitable methods. Trees to be left standing and uninjured will be designated by special markings placed on the trunks at a height of about six feet above the ground surface.

4. Clearing

Unless otherwise specified, trees and other woody vegetation shall be removed so that remaining stumps extend no higher than 12 inches above the ground surface. All trees not marked for preservation, and all snags, logs, brush, shrubs, stumps, rubbish, and similar materials shall be cleared from within the limits of the marked areas.

5. Disposal

Where brush piles for wildlife are not specified on the drawings, cleared materials shall be disposed of by burning and/or burying at locations shown on the drawings, or shall be disposed of by methods and at sites selected by the contractor and approved by the NRCS inspector. Materials to be buried shall be placed at least two feet below the surrounding ground line, and shall be covered by at least two feet of soil with the soil surface graded to drain.

The contractor is responsible for complying with all applicable laws and regulations and the payment of any and all fees that may result from disposal at locations away from the construction site.

CLEARING AND GRUBBING (SD-2)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of clearing, grubbing and disposal of trees, snags, logs, brush, shrubs, stumps, and rubbish from the designated areas.

2. Protection of Existing Vegetation

Trees and other woody vegetation designated to remain undisturbed shall be protected from damage throughout the entire construction period. Vehicles, stockpiled materials, and/or ground disturbance shall not be allowed within the dripline of the vegetation designated to remain in place. The contractor shall repair any damage resulting from the contractor's operations or neglect.

3. Marking

Limits of the areas to be cleared and grubbed will be marked by stakes, flags, tree markings, or other suitable methods. Trees to be left standing and uninjured will be designated by special markings placed on the trunks at a height of about six feet above the ground surface.

4. Clearing and Grubbing

Unless otherwise specified, all stumps, roots, and root clusters that have a diameter one inch or larger shall be grubbed out to a depth of at least two feet below subgrade for concrete structures and one foot below ground surface for embankment and other designated sites. All trees not marked for preservation, and all snags, logs, brush, shrubs, stumps, rubbish, and similar materials shall be cleared from within the limits of the marked areas.

5. Disposal

Where brush piles for wildlife are not specified on the drawings, cleared, and grubbed materials shall be disposed of by burning and/or burying at locations shown on the drawings or shall be disposed of by methods and at sites selected by the contractor and approved by the NRCS inspector. Materials to be buried shall be placed at least two feet below the surrounding ground line and shall be covered by at least two feet of soil with the soil surface graded to drain.

The contractor is responsible for complying with all applicable laws and regulations and the payment of any and all fees that may result from disposal at locations away from the construction site.

CONCRETE (CLASS 3500) (SD-12A)
CONSTRUCTION SPECIFICATIONS

1. Scope

The work shall consist of furnishing, forming, placing, finishing, and curing portland cement concrete.

2. Materials

Portland Cement shall conform to the requirements of ASTM C150, Type II or IIA, and shall be low alkali unless otherwise specified.

Cement that is partially hydrated or otherwise damaged shall not be used.

Fly ash shall conform to the requirements of ASTM C618, Class C or F except, loss ignition shall not exceed 3 percent.

Blast-furnace slag used as a partial substitute for portland cement shall conform to ASTM C989 for ground granulated blast-furnace slag.

Aggregates shall conform to the requirements of ASTM C33. Coarse aggregates shall be size 467 (1/2 inch to No. 4 sieve) unless otherwise specified.

Aggregates known to have a slight potential reactivity with alkalis in cement may be used if low alkali cement is used.

Aggregates shall be handled in a manner to prevent contamination and segregation.

Water shall be clean, free of harmful chemicals, and suitable for drinking.

Water-reducing and/or **Retarding admixtures** shall conform to the requirements of ASTM C494.

Air-entraining admixtures shall conform to the requirements of ASTM C260. If air-entraining cement is used, any additional air-entraining admixture shall be of the same type as that used in the cement.

Plasticizing admixtures shall conform to ASTM C1017.

Preformed expansion joint filler, when specified, shall conform to ASTM D1752 or shall be as shown on the drawings.

Curing compound sprayed on concrete surfaces to retard water loss during curing, shall be white pigmented or have fugitive dye and meet ASTM C309, Type 2 or Type 1, with a fugitive dye as specified on the drawings or dictated by temperature.

3. Concrete Mix Design

The contractor is responsible for design and proportioning concrete mixes. Job mixes shall be prepared to meet quality, consistency, and strength of concrete specified. Prior to placement of concrete, a statement of materials and mix proportions (including admixtures) to be used, shall be furnished to the NRCS inspector.

Calcium chloride, Sodium chloride (salt) or other corrosive accelerators shall not be used.

Fly ash may be used as a partial substitution for portland cement in an amount not greater than 25 percent (by weight) of cement in the concrete mix.

Ground granulated blast-furnace slag may be used as a partial substitution for portland cement in amounts between 25 and 70 percent (by weight) of cement in the concrete mix.

Approval of the concrete mix will be based on the following criteria:

Concrete shall have a minimum compressive strength of 3,500 pounds per square inch at 28 days.

The mix must contain at least six bags of cement per cubic yard of concrete.

Concrete shall contain not more than six gallons of water per bag of cement including free water in the aggregate.

Concrete air-entrainment must be between four and seven percent by volume.

Consistency of concrete must allow it to be worked into place without segregation. Unless otherwise specified, slump must be between two and five inches.

4. Inspection and Testing

The following tests will be performed by the methods indicated.

Type of Test	ASTM Test
Sampling	C172
Slump Test	C143
Air Content	C231 or C173
Compressive Test Specimens	C31 or C42
Compressive Strength Testing	C39 or C42

For each ASTM C31 strength test, three test specimens shall be made. The test result shall be the average of the strengths of the three specimens, except if one specimen in the test shows evidence of improper sampling, molding or testing, it shall be discarded and the strengths of the remaining two specimens averaged. If more than one specimen shows such defects, the entire test shall be discarded.

The NRCS inspector shall have free access to the plant and equipment furnishing concrete. Proper facilities shall be provided for inspection of materials, equipment and processes and to obtain samples of ingredients and concrete. All tests and inspections will be conducted in a way that does not unnecessarily interfere with concrete manufacture and delivery.

5. Handling and Measuring Materials

Materials shall be stored and handled in a manner that will prevent degradation, segregation, contamination, or intermixing of materials before proportioning.

Scales for weighing aggregates and cement shall be a springless type, clean, and operating within one percent accuracy.

All materials entering the concrete shall be measured accurately by weight except liquids may be measured by volume.

6. Mixers and Mixing

Mixers must be capable of thoroughly mixing concrete ingredients into a uniform mass within the specified mixing time and discharging the mix without segregation. Each mixer or agitator shall bear a manufacturer's rating plate indicating the rated capacity and recommended speeds of rotation, and shall be operated within these recommendations. Truck mixers and agitators must be equipped with revolution counters.

Concrete shall be uniform and thoroughly mixed when delivered to the structure.

Mixing water in excess of the job mix amount may not be added to the concrete without written approval of the NRCS inspector.

When concrete is mixed in a drum truck mixer, the total volume of all ingredients to be mixed shall not exceed 63 percent of the gross volume of the drum. The concrete ingredients shall be mixed between 70 and 100 revolutions of the drum or blades at the speed designated by the manufacturer as mixing speed. Mixing in excess of 100 revolutions shall be at the speed designated by the manufacturer as agitating speed. Unless otherwise specified, the filled drum shall not be rotated more than 300 revolutions before discharge of the concrete.

When ready-mix concrete is used, a delivery ticket must be provided showing time of loading, revolution counter reading at time of loading, and material quantities used for each load of concrete.

7. Forms

Forms shall be wood, plywood, metal, fiberglass or other approved material and shall be mortar tight. The forms and associated falsework shall be substantial and unyielding and shall be constructed so that the finished concrete will conform to the specified dimensions and contours. Form surfaces shall be smooth and free from holes, dents, sags, or other irregularities. Forms shall be coated with a nonstaining form release agent before being set into place. Forms shall not be embedded in the concrete. Except as shown on the drawings, all permanently exposed concrete edges shall be chamfered 3/4 inch.

Metal ties or anchorages that will be embedded in the concrete shall be equipped with cones, she-bolts, or other devices that permit their removal to a depth of at least one-inch without injury to the concrete. Ties designed to break off below the surface of the concrete shall not be used without cones. If approved, fiberglass or plastic ties are used, the tie ends shall be cut flush with the finished concrete and ground smooth.

8. Preparation of Forms and Subgrade

Before placement of concrete, the forms, embedments, and subgrade shall be free of chips, sawdust, debris, water, ice, snow, extraneous oil, or other harmful substances or coatings. Any form release agent on reinforcing steel or other surfaces required to be bonded to the concrete, shall be removed.

Rock surfaces shall be cleaned by high-pressure water, sandblasting, or wire brush scrubbing as necessary, and shall be wetted immediately prior to concrete placement. Earth surfaces shall be firm and damp. Concrete must not be placed on mud, dried earth, noncompacted fill, or frozen subgrade. Ice, snow, and frost shall be removed, and the temperature of all surfaces, including reinforcing steel and other metal to be in contact with the new concrete shall be between 40^{o}F and 90^{o}F.

Items to be embedded in the concrete shall be positioned accurately and anchored firmly.

Weepholes in walls or slabs shall be formed with nonferrous material.

9. Conveying

Concrete shall be delivered to the site and discharged completely into the forms within 1.5 hours, after introduction of cement to the mix. In hot or very dry weather, or under conditions contributing to quick stiffening of the concrete, the time between introduction of the cement to the mix and discharge shall not exceed 45 minutes. An appropriate time extension may be allowed when the setting time of the concrete is increased by an approved admixture.

Concrete must be conveyed from the mixer to the forms as rapidly as practicable by methods that prevent segregation of aggregates or loss of mortar. Concrete must not be dropped more than five feet vertically, except where suitable equipment is used to prevent segregation.

10. Placing

The NRCS inspector shall be notified of the time when concrete will be poured and given adequate time to inspect and approve reinforcing steel, forms, subgrade, vibrating equipment, and preparation for placement, finishing, and curing. Concrete shall not be placed until the equipment, subgrade, forms, steel reinforcement, and other embedments have been inspected and approved.

For walls and columns, subsequent higher placements of concrete shall not be placed until concrete below has gained sufficient strength to support dead and superimposed loads without distress.

All equipment and materials required for concrete finishing and curing must be available at the construction site prior to concrete placement.

Concrete shall be deposited as closely as possible to its final position in the forms. The concrete shall be worked into the corners and angles of the forms and around all reinforcement and embeded items to prevent segregation of aggregates or laitance. Deposition of concrete shall be regulated so that the concrete can be consolidated with a minimum of lateral movement. Concrete placed against a sloping surface shall start at the lowest elevation and work upwards to the highest elevation.

11. Layers

Slab concrete shall be placed to design thickness in one continuous layer unless otherwise specified. Formed concrete shall be placed in horizontal layers not more than 20 inches deep.

Successive layers of fresh concrete between construction joints shall be placed at a rate fast enough that the preceding layer is still plastic and can be easily mixed with the fresh concrete, preventing seams (cold joints) or planes of weakness. Where a successive layer can not be placed in a timely manner, a standard type construction joint shall be constructed between layers, and unfinished ends of partial layers shall be formed by a vertical bulkhead.

12. Consolidating

Each layer of concrete must be completely consolidated by spading, hand tamping, and/or mechanical vibration. Vibration shall compact the concrete and bring it into intimate contact with the forms, reinforcing steel, and other embedded items while removing voids and pockets of trapped air. Applied vibration shall extend into previously placed layers of fresh concrete at all points to insure effective bond between layers.

The vibration process must not cause segregation of the mortar and aggregate or cause water or cement to flush to the surface. Vibrators may not be used to transport concrete in the forms or conveying equipment and shall not be applied directly to the reinforcing steel, forms, or hardened concrete.

13. Construction Joints

Construction joints shall be made at locations shown on the drawings except as approved by the NRCS inspector.

Where a feather edge would be produced at a construction joint (as in the top surface of a sloping wall), an insert form shall be used so that the resulting edge thickness on either side of the joint is not less than six inches.

Nonvertical construction joints in structural elements, such as walls and columns, shall be consolidated and screeded to grade unless otherwise specified. Unless otherwise specified, construction joints shall be covered and wet cured for seven days or until concrete placement is resumed.

Steel tying, form construction, and concrete placement next to in-place concrete shall not be started until the hardened concrete has cured at least 12 hours. Before new concrete is deposited on or against hardened concrete, the forms shall be retightened.

The surface of construction joints shall be cleaned of all unsatisfactory concrete, laitance, coatings, stains, or debris by washing and scrubbing with a wire brush or wire broom, or by other means approved by the NRCS Inspector. The surfaces shall be kept moist for at least one hour before the new concrete is placed.

14. Expansion and Contraction Joints

Expansion and contraction joints shall be made only at locations shown on the drawings. Exposed concrete edges at expansion and contraction joints shall be carefully tooled or chamfered and the joints shall be free of mortar and concrete.

Preformed expansion joint filler shall be held firmly in the correct position as the concrete is placed and shall be left exposed for its full length with clean and true edges.

15. Waterstops

Waterstops shall be held firmly in the correct position as the concrete is placed.

16. Removal of Forms

Forms, supports, and protective coverings shall be removed as soon as practical after the concrete has been in place for the times shown in the following table. Removal shall be done so that the concrete surface is not damaged and sudden or excessive stresses are not induced.

Forms shall not be removed before expiration of the following minimum time intervals after concrete placement, exclusive of days when the minimum temperature of the air adjacent to the concrete is below 50^{o}F. The times apply only to normal types of concrete.

Forms	**Minimum Time Before Form Removal**
Sides of slabs or beams	12 hours
Undersides of slabs or beams designed for significant later applied loads	
< 10 feet clear span	4 days
10 to 20 feet clear span	7 days
>20 feet clear span	14 days
Undersides of slabs or beams designed only for dead weight upon form removal	
<10 feet clear span	8 days
10 to 20 feet clear span	14 days
>20 feet clear span	28 days

Sides of walls or columns with no significant horizontal loads applied

<10 feet height above forms	12 hours
10 to 20 feet height above forms	24 hours
>20 feet height above forms	72 hours

17. Finishing Formed Surfaces

Immediately after form removal:

All fins and irregular projections shall be removed from exposed surfaces.

The holes produced by the removal of form ties, cone-bolts, and she-bolts shall be cleaned, wetted, and filled with dry-pack mortar. The mortar shall consist of one part portland cement, three parts sand that will pass a No. 16 sieve, and just enough water to produce a consistency that the filling is at the point of becoming rubbery when the material is solidly packed.

18. Finishing Unformed Surfaces

Unformed surfaces (excluding slip-formed surfaces) exposed in the final work, shall be accurately struck off to grade and then float finished except as otherwise specified. Excessive floating or troweling of surfaces while the concrete is soft is not permitted. Adding dry cement or water to the surface of the screeded concrete to expedite finishing is not allowed.

Exposed concrete edges and joints shall be chamfered or finished with molding tools.

19. Curing

Concrete shall be prevented from drying for at least seven days after placement. Exposed surfaces shall be kept continuously moist for the entire period or until curing compound is applied. Concrete needing repairs must be kept wet and free of curing compound until the repairs are made.

Moisture shall be maintained by sprinkling, flooding, or fog spraying, or by covering with plastic or continuously moistened canvas, cloth, straw, earth, or sand. In place, wood forms shall be kept continuously wet.

The application of water or covering shall not erode, mar, or otherwise damage the concrete. Black colored covering must not be used in hot weather.

Curing compound shall be thoroughly mixed before applying and shall be agitated during application. Curing compound shall be applied at a uniform rate of not less than 1 gallon per 175 square feet of surface. The applied compound must form a uniform, continuous, adherent film that does not check, crack, or peal. Surfaces that are damaged during the curing period, shall be recoated in the same manner as the original application.

Curing compound must not be applied to surfaces requiring bond with concrete remaining to be placed, or with construction joints, reinforcing steel, or other embedded items.

20. Concrete Repair or Replacement

The contractor shall repair or replace concrete that does not meet requirements of this specification.

Prior to starting repair work, the NRCS inspector's approval of the repair plan shall be obtained.

When proprietary patching material is proposed in the plan, the manufacturer's data sheets and written recommendations shall be included in the plan.

21. Cold Weather Concrete Placement

Concrete shall not be placed when the daily minimum air temperature is less than 40^{o}F unless facilities are provided to prevent freezing the concrete during the first 24 hours after placement.

Calcium chloride, Sodium chloride (salt) and other corrosive accelerators shall not be used.

22. Hot Weather Concrete Placement

The temperature of concrete must be maintained below 90^{o}F during mixing, conveying, and placing. During hot, sunny, dry, low humidity, and/or windy conditions, exposed fresh concrete surfaces that tend to set too rapidly shall be continuously moistened using fog sprays or other means to maintain adequate moisture during the time between placement and finishing. Water shall not be sprinkled or added directly to the surface of the concrete before finishing.

After initial set, the concrete shall be kept continuously wet until completion of the curing period or application of curing compound. In hot weather, curing compound used shall have white pigment.

CONCRETE FOR MINOR STRUCTURES (GENERALLY FOR STRUCTURES <10 CU. YD.) (SD-12B) CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of proportioning, forming, placing, finishing, and curing portland cement concrete.

2. Materials

Portland Cement shall conform to ASTM C150, Type II or IIA, and shall be low alkali. Partially hydrated or damaged cement shall not be used.

Aggregates shall conform to the requirements of ASTM C33. Coatse aggregates shall be size 467 (1/2 inch to No. 4 sieve) unless otherwise specified. Aggregates must be free of contamination and segregation.

Water shall be clean, free of harmful chemicals, and suitable for drinking.

Air-entraining admixtures must follow the manufacturer's recommendations.

3. Concrete Mix Design

The contractor, or person in charge of construction, shall be responsible for designing a concrete mix that will produce 3,000 pounds per square inch compressive strength at 28 days and meet the following requirements:

The concrete mix must contain less than six gallons of water per bag of cement.

The mix must contain at least six bags of cement per cubic yard of concrete.

Air-entrainment shall be between four and seven percent by volume.

Concrete slump after mixing must be between two and five inches.

Use of Ready Mixed concrete meeting this specification is encouraged. Upon request, the vendor must provide the owner and NRCS inspector a signed delivery ticket giving the quantities of concrete, cement, fine aggregate, coarse aggregate, and water contained in the batch.

Calcium chloride, Sodium chloride (salt) or other corrosive accelerators shall not be used.

4. Concrete Forms

Forms shall be wood, plywood, metal, fiberglass, or other approved material. The forms and associated falsework shall be substantial and unyielding and shall be constructed so that the finished concrete will conform to the specified dimensions and contours. Form surfaces shall be smooth and free from holes, dents, sags, or other irregularities. Forms shall not be embedded in the concrete.

5. Placing Concrete

Concrete shall be placed in final position within 1.5 hours after adding cement (water if using sack-crete premix) to the mix.

Earth surfaces under concrete shall be compacted and free of debris, frost, ice, or flowing water. Concrete shall not be dropped more than five feet vertically without use of equipment designed to prevent segregation.

Each layer of concrete must be completely consolidated by spading, hand tamping, and/or mechanical vibration. Vibration shall compact the concrete and bring it into intimate contact with the forms, reinforcing steel, and other embedded items while removing voids and pockets of trapped air.

Unformed concrete surfaces (excluding slip-formed surfaces) exposed in the completed work shall be accurately struck off to grade and then float finished. Concrete edges exposed in the final work shall be chamfered or finished with molding tools.

Concrete shall be placed at air temperatures between 40^{o}F and 80^{o}F unless special measures are taken to protect the concrete. Concrete must be protected from freezing for 24 hours after placement.

6. Curing

All concrete shall be cured by keeping all exposed surfaces wet for 7 days (counting only days above 50^{o}F). Alternately, the wet cure process can be stopped when curing compound is applied as recommended by the manufacturer.

7. Defective Concrete

Honey combed areas and other voids in concrete must be promptly repaired with mortar patching immediately upon discovery.

Damaged concrete and concrete not meeting requirements of this specification will be rejected.

CONCRETE PIPELINE (SD-22)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of furnishing and installing concrete pipe and/or concrete drain tile and the necessary fittings as shown on the drawings.

2. Materials

Concrete pipe and fittings shall conform to Material Specification SD-53 for the specified pipe.

3. Laying and Bedding and Thrust Blocks

Pipe and tile shall be laid to the line and grade shown on the drawings. Unless otherwise specified, belled pipe shall be laid with the bells facing upstream. Adequate bell clearance in the subgrade/bedding shall be provided.

Concrete cradles or bedding - Pipe to be cradled or bedded on concrete shall be set to the specified line and grade and temporarily supported on precast concrete blocks or wedges until the cradle or bedding concrete is placed. Concrete blocks or wedges used to temporarily support the pipe during placement of bedding or cradle shall be constructed of concrete equal or stronger than the cradle or bedding concrete.

Earth, sand, or gravel bedding - The pipe shall be uniformly bedded throughout its entire length to the depth and in the manner specified on the drawings. The pipe shall be loaded sufficiently to prevent displacement during backfilling around the sides.

Perforated pipe shall be laid with the perforations down and oriented symmetrically about the vertical centerline. Perforations shall be clear of obstructions when the pipe is laid.

Elliptical pipe and pipe with elliptical or quadrant reinforcement shall be laid so the vertical axis, as indicated by markings on the pipe, is in a vertical position.

Thrust blocks - Specified thrust blocks must be formed against solid, compact earth. They shall be constructed of concrete and the space between the pipe and trench wall shall be filled to top of pipe. The block shall have a minimum thickness of six inches except that design details shown on the drawings shall be followed.

4. Joints

Pipe joints shall conform to the details shown on the drawings. Except where unsealed joints are specified, pipe joints shall be sound and watertight at the pressure specified.

5. Joining Bell and Spigot Pipe

Rubber gasket joint, pressure pipe - Just before joining, connecting joint surfaces shall be thoroughly cleaned and dried. Also, the rubber gasket and joint surfaces shall be lubricated with a light film of soft vegetable soap (flax soap). The rubber gasket shall be stretched uniformly as it is placed in the spigot groove to ensure a uniform volume of rubber around the circumference of the pipe. Manufacturer's recommendations shall be followed. Proper gasket seating shall be checked by feeler gage.

Rubber gasket joints for sewer, culvert, or irrigation pipe - The pipe shall be joined following manufacturer's recommendations except as otherwise specified.

Unsealed joints - When unsealed joints are specified, they shall conform to the requirements shown on the drawings.

6. Joining Tongue and Groove Pipe

Mastic sealed joints - Following manufacturer's recommendations, strips of preformed sealing compound shall be applied to the tongue and groove before assembly of the joint. Any compound extruded from the interior side of the joint during assembly shall be trimmed even with the pipe surface.

Rubber gasket joints - Except as otherwise specified, gasket manufacturer's recommendations shall be followed.

Unsealed joints - Details shown on the drawings shall be followed.

7. Backfill

Backfill shall be placed to final grades (including mounding for settlement) shown on the drawings. Backfill within two feet of the pipe shall be free of debris, rocks, or other objects three inches nominal diameter or larger. Final backfill shall be placed in approximately uniform, void free, compacted layers.

8. Testing

Testing must demonstrate that all pipelines function properly at design pressure and flow. At and below design capacity there shall be no objectionable surge, leakage, unsteady delivery of water, detrimental flow from vents or stands, water hammer, or damage to the system.

9. Bases of Acceptance

The acceptability of the pipeline shall be determined by inspections to check compliance with design requirements.

10. Certification and Guarantee

The installing contractor shall certify that his or her installation complies with the installation design requirements. The certification must list the markings on the pipe and identify the pipe manufacturer.

The contractor must furnish the owner a written guarantee covering defective materials and installation for a period of at least one year.

CORRUGATED METAL PIPE (SD-15)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of furnishing and placing circular, arched, or elliptical corrugated metal pipe and fittings as shown on the drawings.

2. Materials

Corrugated steel pipe shall conform to Material Specification SD-50. Aluminum corrugated pipe shall conform to Material Specification SD-51.

3. Handling the Pipe

The contractor shall furnish equipment as necessary to install the pipe without damaging the pipe or coating. The pipe shall be transported and handled in a manner that will prevent damage to the pipe, coating, or appurtenances.

4. Repair of Damaged Coating

Damage to metallic coating shall be repaired as follows. Clean the damaged surface area by sand blasting, power disk sanding, or wire brushing. Remove all dirt, products of corrosion, and loose and cracked coating. Remove oil and grease material with a solvent. Paint the clean and dry surface using one of the following options.

a. Zinc dust - zinc oxide primer, ASTM D79 and D520
b. Zinc dust paint, ASTM 4146

When metallic coating is damaged in any individual area larger than 12 square inches or when more than 0.2 percent of the total surface area of a single pipe section is damaged, that section of pipe will be rejected.

Breaks, scuffs, or weld damage areas in bituminous coatings shall be repaired by a coat of cold-applied bituminous mastic at least 0.05 inch thick. When individual breaks exceed 36 square inches or when the total area of breaks exceeds 0.5 percent of the total surface of an individual pipe section, that section will be rejected.

Breaks, scuffs, or weld damage areas in polymer coatings shall be repaired by application of a polymer material similar to and compatible with the durability, adhesion, and appearance of the original polymer coating, as described in ASTM A849, paragraph 6.8. When individual breaks exceed 36 square inches in area or when the total area of breaks exceeds 0.5 percent of the total surface area of the individual pipe section, that section of pipe will be rejected.

5. Laying and Bedding the Pipe

Unless otherwise specified, the pipe shall be installed in accordance with the manufacturer's recommendations. Pipe shall be installed so no reversal of grade exists between joints except as shown on the drawings. The pipe shall be installed with the outside laps of circumferential joints pointed upstream and with longitudinal laps at the sides near the vertical mid-height of the pipe.

Field welding of corrugated steel pipe is not permitted. Pipe sections shall be joined with specified, fabricator-supplied coupling bands. Couplings shall be installed as recommended by the fabricator.

Perforated pipe shall be installed with the perforations down and oriented symmetrically about a vertical centerline. Perforations shall be clear at the time of installation.

The pipe shall be firmly and uniformly bedded throughout its full length. Except as shown on the drawings, pipe must be laid on moist, compacted foundation, with a two to three inch layer of loose moist soil adjacent to the bottom of the pipe.

6. Earth, Sand, or Gravel Backfill

Backfill shall be as shown on the drawings. During backfilling, the pipe shall be loaded sufficiently to prevent displacement.

Except as otherwise specified, backfill around the pipe shall be placed in layers not more than four inches thick before compaction. Each layer of backfill shall be compacted to the density and moisture requirements specified for adjacent fill. Backfill around the pipe shall be brought up uniformly on both sides and shall extend a minimum of two feet over the pipe before large machines travel over the pipe.

7. Concrete Backfill

Where concrete backfill is shown on the drawings, the specified requirements must be met. The pipe must be loaded or anchored sufficiently to prevent displacement during concrete placement. The pipe must not be in contact with other embedded metal items such as steel reinforcement.

Where aluminum or aluminum coated pipe is shown to be embedded in concrete, the pipe surfaces to be in contact with concrete shall be coated with two coats of a bituminous paint of the cutback type.

DIVERSION (SD-25)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of excavation, shaping, grading, and earthfill required to construct the diversions shown on the drawings or as staked in the field.

2. Site Preparation

Excavation and fill areas shall be stripped to remove vegetation, trash, and other unsuitable materials prior to diversion construction. Heavy sod shall be stripped to a depth of at least six inches, and the resulting surface scarified. All existing dead furrows and gullies shall be filled before construction or the work shall be part of the construction. All existing terraces, fence rows, and other obstructions shall be removed as necessary to install the diversions as designed.

Existing steep slopes shall be flattened to 1:1 or flatter before fill placement.

3. Fill Material

Earth material used in construction of earthfills shall be suitable material obtained from required excavations or designated borrow areas. Material for earth fills shall be free of frozen material, brush, roots one inch diameter or larger, sod, stones over six inches diameter, or other objectionable material.

4. Diversion Construction

a. Fill shall be placed in layers not more than nine inches thick. All areas of each layer must be compacted by not less than one tread track of the construction equipment.
b. When specified on the drawings, topsoil shall be stockpiled and spread over excavations and other areas to facilitate restoration of productivity.
c. Tops of constructed diversion ridges shall be at design height plus 10 percent overfill for settlement.
d. Cuts in ridges and fills in low areas may be required to maintain design alignment and grades.
e. Disturbed areas shall be left reasonably smooth for seeding.

DORMANT WOODY PLANTINGS (CUTTINGS, STAKES, AND POSTS) (SD-484)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of furnishing all labor, equipment and material for site preparation and planting the designated species of trees and shrubs in the designated areas as specified. The work includes following specified plant establishment procedures for specified dormant woody cuttings, stakes, and/or posts.

2. Materials

Materials will be as indicated on the drawings.

Plant materials must be healthy, native species or other species adaptable to the planting site. Plant material diameter and length shall be as follows:

a. **Dormant cuttings** must be 1/2 to 1 inch in diameter and 12 to 24 inches in length.
b. **Dormant stakes** must be 1 to 3 inches in top diameter and 18 to 36 inches in length.
c. **Dormant posts** must be at least three inches in top diameter and long enough to reach saturated soil. Minimum length is seven feet.

Material preparation must follow proper procedures to assure survival. Except as specified on the drawings, materials must be selected from young, vigorous, healthy stock located within 50 miles of the planting site. Make clean cuts and avoid split ends. Trim side branches to leave the bark ridge and branch collar intact. Butt ends shall be tapered to facilitate driving and proper planting orientation. Top ends must be cut flat to allow driving and to distinguish tops from butts.

Material storage and protection - Collected and prepared plant materials must not be allowed to dry out. For best results, plant materials the same day they are cut and prepared. Materials must be kept moist during storage, transport, and all other times prior to planting. The butt end of plant materials (one foot length minimum) must be kept submerged in water until planting.

Material certification - Prior to planting, the contractor shall furnish the NRCS inspector a written certification (signed and dated) that the plant materials meet requirements of this specification. The certification must include the following as appropriate:

a. For commercial plants - species and/or varieties and the number of plants, condition, size, age, source of production, and date supplied to the contractor (signed and dated by the supplier).
b. For native harvested materials - the species and location of origin (section, township, and county), the date the material was cut (supplier signed and dated).
d. Dates and locations plant materials were stored.
e. The name of the project where the plant material is to be planted.

3. Planting Site Preparation

Prior to planting, the site must be prepared as shown on the drawings.

4. Planting

Dormant plant material must be planted in unfrozen ground between October 15 and the following May 15. Spring planting must occur before the plant buds have broken dormancy.

Plant materials must be planted with the butt end down. Set the butt end of the plant material at least 12 inches into a moist soil layer. Plant material must be planted as deep as possible (at least 40 percent of total length below ground), but at least two lateral buds and or terminal bud scar must be above ground.

To avoid plant damage in most soils, holes should be created before insertion or driving of materials.

Good contact must be established between the soil and plant material (tamp if necessary), but avoid excessive damage to the bark, especially stripping. When driving dormant stakes or posts, care must be taken to avoid splitting. Cut four to six inches from the tops of stakes and posts damaged by driving.

Stakes and posts located in water must extend at least 12 inches above normal water level.

DRAINFILL AND FILTER (SD-9)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of furnishing, placing, and compacting drain fill and filter sands and/or gravels.

2. Materials

Aggregates shall be sand, gravel, crushed stone, or mixtures thereof, composed of clean, hard, durable mineral particles free of organic matter, clay balls, soft particles, or other substances that would interfere with free draining properties of the aggregates.

Not more than 5 percent of the material may be limestone, and not more than 15 percent may be flat elongated particles.

The aggregates shall meet the following gradation requirements except as otherwise specified.

Filter Aggregate Size	% Finer by Weight
3"	100
1"	90 to 100
No. 4	50 to 85
No. 50	10 to 40
No. 200	0 to 5

3. Subgrade Preparation

Surfaces on which drain fill will be placed shall be as undisturbed as possible (do not scarify), and must be free of standing water during placement of drain aggregates. Care shall be taken to prevent collapse of drain walls.

4. Placement

Drain fill shall not be placed until the subgrade has been made available for inspection by the NRCS inspector. Drain fill shall not be placed around pipes until the pipe installation has been made available for inspection by the NRCS inspector.

Material must be placed in uniform, approximately six-inch thick layers. Extreme care shall be taken to assure uniformity of the drain fill, and to prevent segregation or contamination of the drain fill with foreign mater. When collector pipes are included in drains, the fill materials shall be placed in a manner to avoid displacing the pipe.

EXCAVATED POND (DUGOUT) (SD-6)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of constructing an excavated pond (dugout) at the locations shown on the drawings.

2. Excavation

Excavation shall be to the lines and grades shown on the drawings. The excavation shall be completed to a workmanlike, reasonably smooth finish.

3. Waste Disposal

Excavated material shall be placed in the location and manner shown on the drawings or as directed by the NRCS inspector. It must be left in a condition suitable for seeding without excessive smoothing. Berms shall meet the minimum width shown on the drawings.

4. Livestock Access Ramp

Where a livestock access ramp is shown on the drawings, lines and grades, and the type, size and gradation of materials used will be as shown on the drawings.

5. Seeding

Seeding requirements will be as shown on the drawings.

6. Fence

Fence requirements will be as shown on the drawings.

EARTH FILL - CLASS A (SD-7A) (AG WASTE)
CONSTRUCTION SPECIFICATION

1. Scope

The work will consist of the construction of earth fills where the degree of compaction is to be measured by standard compaction tests or by permeability testing of compacted clay linings.

2. Materials

All fill materials shall be obtained from required excavations and designated borrow areas. Selection, blending, placement, and compaction of fill, will be subject to approval of the NRCS inspector.

Fill materials shall contain no frozen material, sod, roots or other perishable material, or rocks larger than four inches in diameter. Fill shall not be placed on a frozen surface.

3. Foundation Preparation

All foundation (including abutment) surfaces shall be shaped one horizontal to one vertical or flatter except as otherwise specified.

After stripping (see stripping specification), the foundation shall be loosened thoroughly by scarifying or plowing to a minimum depth of six inches. The foundation shall then be compacted to the density and moisture requirements specified for the fill. Areas that are too low after stripping and shaping must be filled to base grade with compacted fill equal to that used in other parts of the project.

4. Placement

All foundation excavation and preparation shall be completed before placing fill. After placement, fill materials must be spread and blended by motor grader or other approved equipment. Except as required by the drawings, fill material shall be mixed and uniformly placed throughout the entire fill without lenses, streaks, pockets, or layers of material that differ significantly from surrounding material.

Placement and compaction methods must prevent damage to structures and allow the structure to assume backfill loads gradually and uniformly. Within 2 feet of any structure, fill layer thickness must not exceed 4 inches and equipment loads must not exceed 400 pounds.

Fill shall be placed in approximately horizontal layers. Except as described above, fill layer thickness shall not exceed six inches for compaction by large machines or four inches for small hand directed power tampers.

If the surface of any layer becomes too hard and smooth for proper bond with the succeeding layer, it shall be scarified parallel to the axis of the fill, to a depth of not less than two inches, before the next layer is placed.

Except as otherwise specified, openings temporarily left in dam fills (for pipe installation, streamflow, etc.,) shall have side slopes three horizontal to one vertical or flatter. When filling the opening, the bonding surface of the fill in place shall be stripped of all material not meeting the requirements of this specification and shall be scarified, moistened, and recompacted as new earthfill is placed.

5. Compaction and Control of Moisture Content

Unless otherwise specified, the fill shall be compacted to 90 percent of Standard Proctor (ASTM D698) optimum density at a moisture content within 2 percent of optimum moisture.

During placement and compaction of earthfill, the moisture content of the material being placed shall be maintained within the specified range. Application of water to earthfill material shall be accomplished at the borrow areas insofar as practicable, but may also be applied by sprinkling the material after placement on earthfill. Uniform moisture distribution shall be obtained by disking or blading.

Material that is too wet shall either be removed from the fill or dried to the specified moisture prior to compaction. If the top surface of the preceding layer becomes too dry to permit suitable bond, it shall be removed or scarified, moistened by sprinkling to an acceptable moisture content, and recompacted.

Compaction of fill adjacent to concrete structures shall not be started for at least the following number of days after placement of the concrete.

Concrete Structure	Days After Concrete Placement
Vertical or near-vertical walls with earth load on one side only	14
Walls backfilled on both sides simultaneously	7
Conduits and spillway risers, cast-in-place (with inside forms in place)	7
Conduits and spillway risers, cast-in-place (forms removed)	14
Conduits, pre-cast, cradled	2
Conduits, pre-cast, bedded	1
Anti-seep Collars and Cantilever Pipe Supports (backfill both sides simultaneously)	3

6. Compacted Clay Linings (additional requirements)

Material used for the clay lining must be either Unified Class CL or CH or other material meeting liner seepage requirements of less than $1X10^{-7}$ cm/sec (1/16 inch/day).

Except as shown on the drawings, the compacted clay lining must be at least 18 inches thick. Except as otherwise shown on the drawings, clay linings for ponds must cover the pond bottom and interior side slopes of the pond up to design storage elevation.

Foundation preparation - If in-place material **is not** suitable for lining, the material must be excavated to the depth needed to place lining below final design lines and grades. If in-place material **is** suitable for the lining, excavate to the depth needed to permit mixing and compaction of the first layer of the lining.

Lining placement - Lining fill must be placed in approximately equal thickness, uniform layers.

7. Testing

Density and moisture content of the fill may be tested during construction by the NRCS inspector following the methods described in ASTM D698 and D1556 or equivalent. Tests performed by the NRCS inspector will be used to verify that the earthfills conform to the plans and specifications and not as a replacement for the contractor's quality control program.

The contractor will be responsible for supplying adequate documentation to NRCS to certify moisture and compaction requirements have been met. Optimum moisture, maximum density, and associated test data will be furnished as described by ASTM D698, D1556, D2167 or equivalent.

8. Amount of Testing to be Furnished by the Contractor

Proctor Curves - A minimum of one Moisture-Density (ASTM D698) Standard Proctor Curve and associated test data must be prepared and furnished to NRCS for each type of material to be incorporated into the earth fill (including linings).

In-place Compaction Tests - At least one test must be taken each day Class A earth fill is placed. For earth fills (except clay linings), a minimum of one in-place moisture and density test must be taken for each 2,500 cubic yards of fill placed. For clay linings, at least two in-place tests are required for each acre of each six inch lift, except that the minimum number of tests is four per lift.

Permeability testing alternative for clay linings - Where the above tests are not performed and reported, at least one permeability test (ASTM D3385, D5093 or equivalent) on the completed liner must be conducted per acre of liner, except for this alternative the minimum number of permeability tests is two. These tests must demonstrate that the pond, when full, will have a seepage rate less than $1X10^{-7}$ cm/sec (1/16 inch/day).

EARTH FILL - CLASS A (SD-7A)
CONSTRUCTION SPECIFICATION

1. Scope

The work will consist of the construction of earth fills where the degree of compaction is to be measured by standard compaction tests.

2. Materials

All fill materials shall be obtained from required excavations and designated borrow areas. Selection, blending, placement, and compaction of fill will be subject to approval of the NRCS inspector.

Fill materials shall contain no frozen material, sod, roots or other perishable material, or rocks larger than six inches in diameter. Fill shall not be placed on a frozen surface.

3. Foundation Preparation

All foundation (including abutment) surfaces shall be shaped one horizontal to one vertical or flatter except as otherwise specified.

After stripping (see stripping specification), the foundation shall be loosened thoroughly by scarifying or plowing to a minimum depth of six inches. The foundation shall then be compacted to the density and moisture requirements specified for the fill.

4. Placement

All foundation excavation and preparation shall be completed before placing fill. After placement, fill materials must be spread and blended by motor grader or other approved equipment. Except as required by the drawings, fill material shall be mixed and uniformly placed throughout the entire fill without lenses, streaks, pockets, or layers of material that differ significantly from surrounding material.

Placement and compaction methods must prevent damage to structures and allow the structure to assume backfill loads gradually and uniformly. Within 2 feet of any structure, fill layer thickness must not exceed 4 inches and equipment loads must not exceed 400 pounds.

Fill shall be placed in approximately horizontal layers. Except as described above, fill layer thickness shall not exceed six inches for compaction by large machines or four inches for small hand directed power tampers.

If the surface of any layer becomes too hard and smooth for proper bond with the succeeding layer, it shall be scarified parallel to the axis of the fill, to a depth of not less than two inches, before the next layer is placed.

Except as otherwise specified, openings temporarily left in dam fills (for pipe installation, streamflow, etc.,) shall have side slopes three horizontal to one vertical or flatter. When filling the opening, the bonding surface of the fill in place shall be stripped of all material not meeting the requirements of this specification and shall be scarified, moistened, and recompacted as new earthfill is placed.

5. Control of Moisture Content

During placement and compaction of earthfill, the moisture content of the material being placed shall be maintained within the specified range. Application of water to earthfill material shall be accomplished at the borrow areas insofar as practicable, but may also be applied by sprinkling the material after placement on earthfill. Uniform moisture distribution shall be obtained by disking or blading.

Material that is too wet shall either be removed from the fill or dried to the specified moisture prior to compaction. If the top surface of the preceding layer becomes too dry to permit suitable bond, it shall be removed or scarified, moistened by sprinkling to an acceptable moisture content, and recompacted.

6. Compaction (Class A)

Unless otherwise specified, the fill shall be compacted using sheepsfoot type tamping rollers to 90 percent of Standard Proctor (ASTM D698) optimum density at a moisture content within 2 percent of optimum moisture.

Compaction of fill adjacent to concrete structures shall not be started for at least the following number of days after placement of the concrete.

Concrete Structure	Days After Concrete Placement
Vertical or near-vertical walls with earth load on one side only	14
Walls backfilled on both sides simultaneously	7
Conduits and spillway risers, cast-in-place (with inside forms in place)	7
Conduits and spillway risers, cast-in-place (forms removed)	14
Conduits, pre-cast, cradled	2
Conduits, pre-cast, bedded	1
Anti-seep Collars and Cantilever Pipe Supports (backfill both sides simultaneously)	3

7. Testing

Density and moisture content of the fill may be tested during construction by the NRCS inspector following the methods described in ASTM D698 and D1556 or equivalent. Tests performed by the NRCS inspector will be used to verify that the earthfills conform to the plans and specifications and not as a replacement for the contractor's quality control program.

The contractor will be responsible for supplying adequate documentation to NRCS to certify moisture and compaction requirements have been met. Optimum Moisture, Maximum Density, and associated test data will be furnished as described by ASTM D698, D1556, D2167, or equivalent.

8. Amount of Testing to be Furnished by the Contractor

Proctor Curves - A minimum of one Moisture-Density (ASTM D698) Standard Proctor Curve and associated test data must be prepared and furnished to NRCS for each type of material to be incorporated into the earth fill.

In-place Compaction Tests - A minimum of one in-place moisture and density test must be taken for each 2,500 cubic yards of fill placed. At least one of these tests must be taken each day Class A earth fill is laced. A copy of these tests must be furnished to the NRCS inspector.

EARTH FILL-CLASS S (SD-7S)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of the construction of compacted earth fills where the amount of compaction is to be controlled by specifying a construction method.

2. Materials

All fill materials shall be obtained from required excavations and designated borrow areas. Selection, blending, placement, and compaction of fill will be subject to approval of the NRCS inspector.

Fill materials shall contain no frozen material, sod, roots or other perishable material, or rocks larger than eight inches in diameter. Fill shall not be placed on a frozen surface.

3. Foundation Preparation

All foundation (including abutment) surfaces shall be shaped one horizontal to one vertical or flatter except as otherwise specified.

After stripping (see stripping specification), the foundation shall be loosened thoroughly by scarifying or plowing to a minimum depth of four inches. The foundation shall then be compacted by the process specified for the fill.

4. Placement

All foundation excavation and preparation shall be completed before placing fill. Except as required by the drawings, fill material shall be mixed and uniformly placed throughout the entire fill without lenses, streaks, pockets, or layers of material that differ significantly from surrounding material.

Placement and compaction methods must prevent damage to structures and allow the structure to assume backfill loads gradually and uniformly. Within 2 feet of any structure, fill layer thickness must not exceed 4 inches and equipment loads must not exceed 400 pounds.

Fill shall be placed in approximately horizontal layers. Except as described above, fill layer thickness shall not exceed nine inches for compaction by large machines or four inches for small hand directed power tampers.

If the surface of any layer becomes too hard and smooth for proper bond with the succeeding layer, it shall be scarified parallel to the axis of the fill, to a depth of not less than two inches, before the next layer is placed.

Except as otherwise specified, openings temporarily left in dam fills (for pipe installation, streamflow, etc.,) shall have side slopes three horizontal to one vertical or flatter. When filling the opening, the bonding surface of the fill in place shall be stripped of all material not meeting the requirements of this specification and shall be scarified, moistened, and recompacted as new earthfill is placed.

5. Control of Moisture Content

At the time of compaction, earth fill shall have a moisture content that when kneaded in the hand will form a ball that does not easily crumble when pressed between the hands. If the soil is too wet, it will yield free water when kneaded in the hand.

Fill materials must be wetted or dried as needed to achieve proper moisture prior to compaction.

6. Compaction (Class S)

Fill layers shall be compacted by one of the following methods.

a. By routing the hauling and spreading equipment such that all points of the fill are traversed by at least one tread track of the loaded equipment traveling parallel to the centerline of the fill.

b. By at least 2 passes of a tamping (sheepsfoot) roller weighing at least 100 pounds per square inch of bearing area.

Fill adjacent to structures shall be compacted to a density equivalent to that of the surrounding fill by means of hand tamping or manually directed power tampers or plate vibrators. Within 2 feet of any structure, equipment loads must not exceed 400 pounds.

Compaction of fill adjacent to concrete structures shall not be started for at least the following number of days after placement of the concrete.

Concrete Structure	Days After Concrete Placement
Vertical or near-vertical walls with earth load on one side only	14
Walls backfilled on both sides simultaneously	7
Conduits and spillway risers, cast-in-place (with inside forms in place)	7
Conduits and spillway risers, cast-in-place (forms removed)	14
Conduits, pre-cast,	2
Conduits, pre-cast,	1
Anti-seep Collars and Cantilever Pipe Supports (backfill both sides simultaneously)	3

EARTH FILL-CLASS U (SD-7U)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of the construction of earth fills where compaction is not required.

2. General

Except as shown on the drawings, earth fills may contain waste materials provided the waste does not cause voids in the fill. Hard objects such as roots, stumps, brush, and rocks shall be buried to a depth of two feet below the finished fill surface. The fill surface shall be left in a smooth condition, blending with the surrounding area.

EXCAVATION (SD-5)
CONSTRUCTION SPECIFICARTION

1. Scope

The work shall consist of excavation required by the drawings and specifications and disposal of the excavated material.

2. Classification

Common Excavation is defined as the excavation of all materials that can be excavated, transported and unloaded using heavy ripping equipment, and heavy rubber tired loaders or scrapers with pusher tractors. This classification includes rocks smaller than one cubic yard.

Rock Excavation is defined as the excavation of all hard, compacted, or cemented materials that require blasting or the use of unusually large ripping and excavating equipment. This classification includes the removal of isolated rocks larger than one cubic yard.

Unclassified Excavation is defined as the excavation of all materials (including rock) encountered, regardless of the nature of the material or the excavation method needed.

3. Use of Excavated Materials

To the extent needed, all suitable materials from excavations shall be used in the construction of specified earth or rock fills. Suitability of materials for specific purposes will be determined by the NRCS inspector. The contractor shall not waste or otherwise dispose of suitable excavated materials.

4. Disposal of Waste Materials

All surplus and unsuitable excavated materials will be disposed of at the locations shown on the drawings or designated by the landowner or NRCS inspector. The disposal site shall be left in a neat condition and sloped to provide drainage.

5. Excavation Limits

Excavated surfaces too steep to be safe without support, shall be supported as necessary to safeguard the work and workers. The width of the excavation shall be increased if necessary to provide space for sheeting, bracing, shoring and other supporting installations. The contractor shall furnish, place, and subsequently remove such supporting installations. Excavation side slopes may be flattened for safety reasons where approved by the NRCS inspector. Excavations shall be completed to specified lines and grades prior to placement of earth fill or construction of structures.

7. Borrow Excavation

When suitable materials from specified excavations are insufficient to construct specified fills, additional material shall be obtained from designated borrow areas. The extent and depth of borrow pits shall be as approved by the NRCS inspector. Borrow pits must be shaped to eliminate unsightly conditions and steep or unstable slopes.

FENCE (SD-30)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of furnishing and installing fences including complete finished gates and fittings.

2. Materials

Wire and fencing shall be of the size and type specified on the drawings. Clips, tie wires, bands or other fabric fasteners must be zinc, cadmium or aluminum coated. Except as otherwise specified, all other steel fencing materials (except posts) shall be galvanized or aluminum coated.

Steel fence posts shall be painted or galvanized round, "T" or "U" shaped cross section with corrugations, knobs, or similar design for fastening and holding horizontal fence wires at proper elevation. Posts shall have a tapered anchor plate to facilitate driving and anchorage. Steel posts shall weigh at least 1.25 pounds per foot excluding anchor plate.

Wood fence posts and braces shall be red cedar, osage orange (Bois d'Arc), or pressure treated wood. At least half the diameter of red cedar wood shall be heartwood. Posts and braces shall be straight, sound, and free from decay.

Other gates and posts shall be as specified on the drawings.

Staples and stays shall be nine-gage galvanized wire except as shown on the drawings. Except as otherwise specified, staples shall be at least one and a half-inch long.

3. Setting Posts

Except as otherwise specified, steel posts shall be driven into the ground at least 24 inches. Except as otherwise specified, other posts shall be installed in the ground at least 30 inches for line posts and 36 inches for brace and corner posts.

Earth backfill around posts shall be thoroughly tamped in four-inch or thinner layers and shall completely fill the hole to a mounded level above ground surface.

Concrete backfill shall be rodded into place in 12 inch or thinner layers and shall completely fill the hole to ground surface. Concrete must set 24 hours before applying stress to the post.

4. Corner Assembly

Except as otherwise specified, corner assemblies shall be installed at all points where fence alignment changes more than 15 degrees.

5. End Panels and Pull Post Assemblies

End panels or pull post assemblies shall be built at gate and fence ends

Except as otherwise specified, pull post assemblies are required at the following locations:

a. In straight fence sections at 825 foot or shorter intervals.
b. In low spots where horizontal wire direction changes more than 15 degrees.
c. At the beginning and end of any 15 degree or larger curve arc.

6. Attachment of Fencing to Posts

Fencing shall be stretched and attached to posts as follows:

a. Place fencing on the outside of posts on curves. Except on curves or as otherwise specified, fencing shall be placed on the side of the post opposite the area being protected.
b. Fencing shall be fastened to end, corner and pull posts by wrapping each horizontal wire strand around the post and tying it back on itself with not less than three tightly wound wraps.
c. Attach fencing to line posts at each barbwire, and at every other horizontal wire on woven wire fencing. Staple wire to wood line posts, but do not drive staples so tightly as to bind the fencing wire. Fasten fencing to nonwood posts using post manufacturer's fasteners or 14 gage or heavier galvanized wire.

d. Splice horizontal fencing wires by wrapping not less than 5 tight wraps of each end around the other wire.

7. Stays

Where specified, install stays half way between posts to maintain horizontal wire spacing.

8. Low Point Fence Installation

Fence across depressions and watercourses shall meet the following requirements. Posts subject to upward force shall be anchored by extra embedment or anchors. Where fencing can not reasonably be placed at proper elevation from the ground, longer posts shall be used and extra fencing installed along the ground to close the gap.

GABION BASKETS AND MATTRESSES (WIRE MESH) (SD-18)
CONSTRUCTION SPECIFICATION

1. Scope

The work consists of furnishing, assembling, and installing rock filled wire mesh gabion baskets and mattresses.

2. Types

Gabions shall consist of rectangular wire mesh formed containers filled with rock. Gabions will conform to the following types:

Woven mesh - Nonraveling, double twisted, hexagonal wire mesh consisting of 2 wires twisted together in 2 180-degree turns.

Welded mesh - Welded wire mesh with a uniform rectangular pattern and a resistance weld at each intersection. Welded wire connections shall conform to ASTM A185, including wire smaller than W1.2 (0.124 inch), except that weld connections shall have a minimum shear strength of 60 percent of the wire minimum ultimate tensile strength.

Gabions - Gabions shall be furnished as manufactured baskets or mattresses as shown on the drawings and shall be fabricated within a dimensional tolerance of plus or minus five percent. Gabion top, bottom, sides, and diaphragm edges shall be connected with strength equal to the strength of the mesh.

3. Material

Wire shall be hot-dipped galvanized, shall have a minimum tensile strength of 60,000 pounds per square inch and meet ASTM A641, Class 3, Soft Temper.

For gabion baskets 12 to 36 inches in height, selvedge galvanized wire shall be at least 0.13 inch in diameter. Lacing and connecting galvanized wire shall be at least 0.08 inch in diameter. All other galvanized wire shall be at least 0.1 inch in diameter. Maximum woven mesh size shall be 4.5 inches. Maximum welded mesh size shall be three inches.

For gabion mattresses 12 inches or less in diameter, selvedge and spiral binder galvanized wire shall be at least 0.1 inch in diameter. All other galvanized wire shall be at least 0.08 inch in diameter. Maximum woven mesh size shall be 3.25 inches. Maximum welded mesh size shall be three inches.

Where polyvinyl chloride (PVC) coated wire is specified, the galvanized wire shall have a minimum 0.02 inch thick ultraviolet light resistant PVC coat.

4. Assembly

Except as otherwise specified, the manufacturer's recommendations shall be followed. All joints, ties and connections shall be made using wire recommended by the manufacturer. Adjoining gabions shall be joined with strength equal to the wire mesh. Tie wires used to connect adjoining gabions shall be separate from tie wires used to assemble individual gabions.

Except as otherwise specified, all gabions shall be installed with lid hinges on the upstream or higher side of the gabion when installed. All gabions shall be stretched on line and grade, to the design dimensions before filling.

GEOTEXTILE (SD-95)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of furnishing all material, equipment, and labor necessary for the installation of geotextiles.

2. Quality

Geotextiles shall conform to the requirements of Material Specification SD-592 and this specification.

3. Storage

Before installation, geotextile shall be protected from damage by weather, sunlight, and other causes.

4. Surface Preparation

The surface on which geotextile is to be placed shall be graded to the lines and grades shown on the drawings. Except as shown on the drawings, the surface shall be reasonably free of loose rock and clods, holes, depressions, projections, water, and muddy conditions.

5. Placement

Before geotextile is placed, the soil surface will be inspected for quality assurance. Geotextile shall be unrolled along the placement area and loosely laid without stretching so that it will conform to surface irregularities without tearing when upper materials are placed. The geotextile may be folded and/or overlapped as needed for proper placement. Geotextile sections shall be joined by sewing or overlapping.

Geotextile sections joined by sewing shall have seams producing minimum seam strength equal to 90 percent of minimum fabric strength. The sewn overlap shall be at least six inches and the sewing shall consist of at least two parallel stitched rows at least one-half inch apart with rows at least two inches from fabric edges. The stitching must be a lock-type stitch. Installed geotextile must be secured to prevent movement during construction.

Geotextile sections joined by overlapping shall be overlapped a minimum of 18 inches and secured to the underlying soil surface using securing pins as provided and recommended by the geotextile manufacturer. Upstream or upslope geotextile sections shall overlap abutting downslope geotextile.

Geotextile tears shall be repaired by overlap (described above) of additional geotextile placed in contact with the torn geotextile.

GRASSED WATERWAY (SD-27)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of excavation, shaping, grading, and earthfill required, to construct the waterways shown on the drawings.

2. Site Preparation

Excavation and fill areas shall be stripped to remove vegetation, trash, and other unsuitable materials prior to waterway construction. All existing terraces, fence rows, and other obstructions shall be removed as necessary to install the waterways as designed.

Waste material shall be disposed of as shown on the drawings or as approved by the NRCS inspector.

Existing steep slopes shall be flattened to 1:1 or flatter before fill placement.

3. Fill Material

Earth material used in construction of earthfills shall be suitable material obtained from required excavations or designated borrow areas. Material for earth fills shall be free of frozen material, brush, roots one inch diameter or larger, sod, stones over six inches diameter, or other objectionable material.

Surplus or unsuitable excavated materials will be disposed of at the locations shown on the drawings or as approved by the NRCS inspector.

4. Waterway Construction

a. Fill shall be placed in layers not more than nine inches thick. All areas of each layer must be compacted by not less than one tread track of the construction equipment.
b. When specified on the drawings, topsoil shall be stockpiled and spread over excavations and other areas to facilitate restoration of productivity.
c. Disturbed areas shall be left reasonably smooth for seeding.

LAND LEVELING (SD-24)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of excavating, transporting, and spreading earth materials to precision grades within fields as shown on the drawings.

2. Site Preparation

All lands to be leveled shall be cleared of brush, trash, and excessive vegetative material prior to leveling.

Except as shown on the drawings, trash and brush materials shall be removed from the site and disposed of in a manner as approved by the NRCS inspector. Other waste materials may be disposed of on site as approved by the NRCS inspector.

3. Excavation and Fill Materials

Earth materials used for fill shall be obtained from areas within the field marked by cut stakes, from designated borrow areas or from other required excavations as shown on the drawings or approved by the NRCS inspector. Fill material shall contain no heavy sod, large rocks, or other objectionable material.

4. Construction and Finish

a. The land shall be leveled to the designated grades shown on the drawings and/or as indicated by the cut and fill stakes placed on the site.
b. For design slopes of 0.0 to 0.4 percent, maximum deviation from design cuts or fill shall be $\pm$ 0.1 foot with no reverse grades. For design slopes over 0.4 percent, maximum deviation from design cuts or fill shall be $\pm$ 0.2 foot with no reverse grades.
c. Overfill all fill areas 10 percent of fill depth for fills up to 1.0 foot deep, and 20 percent of fill depth for fills greater than 1.0 foot deep.
d. Fills shall be placed in layers not more than six inches thick.
e. Leveling operations shall not be performed under wet soil conditions that will result in excessive compaction or destruction of soil structure.
f. Cut and fill stakes shall be maintained until final grade inspection is completed. Small windrows or islands of earth may be left at the stakes until completion of grade inspection. After final grade inspection, spread the windrow or island to blend with final grades.

5. Environmental Concerns

Construction must be completed in a manner that will minimize erosion and/or air and water pollution.

METAL FABRICATION AND INSTALLATION (SD-17)
CONSTRUCTION SPECIFICATION

1. Scope

This specification is applicable to metalwork items not covered by other specifications. It is applicable to such items as trash guards, anti-vortex devices, and similar structures or parts. It is not applicable to concrete reinforcing steel, water control gates, fences, wells, piles, or pipe conduits.

2. Materials

Steel - Except as otherwise specified, steel shall be malleable, weldable, carbon steel.

Bolts, nuts, washers, rods, rivets, etc., shall be a material equal to the steel being fastened.

Aluminum - Except as otherwise specified, aluminum shall be ASTM alloy 6061-T6.

3. Fabrication

Metal items shall be fabricated to close fit, following requirements shown on the drawings. Welds shall be made all around in a manner developing as much strength as possible.

4. Protective Coatings

Galvanizing - Except as otherwise specified, items shown on the drawings to be galvanized, shall be galvanized according to ASTM A123, except bolts, screws, and other fasteners 0.5 inch or less in diameter may be coated with electro-deposited zinc or cadmium coating following ASTM B766 or B633.

Zinc Painting - For items specified to be painted with zinc paint, the surfaces shall be cleaned and painted as follows.

Cleaning - Surfaces to be painted must be clean and dry. Remove oil and grease using a solvent. Clean surfaces to be painted using sand blasting, power disk sanding, or wire brushing.

Paint - Apply two coats of zinc-rich cold galvanized compound using brush, or aerosol application (example: Rust-Oleum Professional Galvanizing Compound) or zinc dust - zinc oxide primer ASTM D79, D520, or D4146.

4. Erection

All parts of the metal structure shall be properly aligned and erected true and plumb, closely conforming to the drawings.

MULCH BLANKETS AND NETS (SD-33)
CONSTRUCTION SPECIFICATION

1. Scope

This work shall consist of furnishing and installing all materials for mulch blankets and nets specified for establishing vegetation.

2. Materials

Mulch Net - Netting to control movement of mulch materials shall be designed for coverage of mulch and shall be manufactured from oriented polypropylene, except as otherwise specified. The net shall have individual opening sizes between and 1 1/2 inch.

Straw erosion control blanket shall be a machine-assembled mat consisting primarily of clean, weed-free straw from agricultural crops. The straw must be evenly distributed throughout the mat with a thickness between 3/8 and 5/8 inch. The top of the blanket shall be covered with a biodegradable plastic mesh with opening sizes between 3/8 and 1 inch. The mesh must be adhered to the straw by a knitting process using biodegradable thread.

Excelsior erosion control blanket (standard weight) shall consist of a machine produced curled wood excelsior mat with at least 80 percent 6-inch or longer fiber and with even distribution and consistent thickness. Fiber diameter shall be between 0.015 and 0.15 inch. The top of the blanket shall be covered with a polypropylene mesh with 3/8 to 3 inch openings. Dry blanket weight shall be at least 0.7 pounds per square yard.

Excelsior erosion control blanket (heavy duty) shall consist of a machine produced curled wood excelsior mat with at least 80 percent 6-inch or longer fiber and with even distribution and consistent thickness. Fiber diameter shall be between 0.015 and 0.15 inch. The top of the blanket shall be covered with a polypropylene mesh with 3/8 to 1 1/2 inch openings. Dry blanket weight shall be at least 1.4 pounds per square yard.

Staples - Except as otherwise specified, staples shall be 11 gage or heavier galvanized steel wire formed into "T" or "U" shape with 6 inch or longer vertical legs. Horizontal measurements of staples must be longer than 2 mesh opening diameters. Horizontal measurements must not be longer than vertical measurements of staples.

3. Installation

Areas to be covered with mulch net or erosion control blankets shall be fertilized and seeded prior to but not more than two days before installation. All rocks, clods, or other objects over one and a half-inch in maximum diameter shall be removed prior to placing mulch. Except as otherwise specified, the following shall apply:

Application Sequence - Nets and/or blankets shall be placed first in the lowest area of water flow and oriented with length in the direction of flow.

Overlap - Up-slope sections must lap on top of lower sections. Side edges must overlap at least 3 inches and ends must overlap at least 12 inches.

Top and bottom ends shall be folded under at least four inches and stapled.

Anchoring - Prior to anchoring the first laid section, adjust net or blanket laterally in ditch or channel to bring both edges to approximately the same elevation. Nets and blankets shall be held in place using staples driven vertically through the mesh into the soil. Nets or blankets must not be drawn taut in stapling. Except as otherwise specified, staples shall be installed in the following pattern:

a. Install a row of staples three feet apart down the low point of all channels and ditches. Place these staples perpendicular to centerline of the ditch.
b. Areas where nets or blankets do not touch the ground shall be secured with extra staples to insure full contact with the soil and/or mulch.
c. Along upper outside edges of the blanketed area where runoff water will flow onto the net or blanket, place a row of staples one foot apart. Where significant ditch or channel water flows pass

onto the blanketed area, bury the leading edge of the blanketed area one-foot deep into the ground.

d. Along lapped seams running perpendicular to runoff water flow, place a row of staples one-foot apart.

e. For all other areas sloped 3:1 or flatter, install staples evenly at the rate of one staple per square yard of net or blanket, and with other edge staples spaced not more than three feet apart.

f. For channel bottoms and areas steeper than 3:1 slope, install staples evenly at the rate of two staples per square yard of net or blanket and with other edge staples spaced not more than two feet apart.

PLASTIC PIPELINE (IRRIGATION) (SD-20)
CONSTRUCTION SPECIFICATION

1. Scope

The work consists of furnishing and installing Poly-vinyl Chloride (PVC), Polyethylene (PE), High Density Polyethylene (HDPE), and Acrylonitrile-Butadine-Styrene (ABS) plastic pipe complete with fittings and appurtenances, as shown on the drawings.

2. Materials

Plastic pipe and fittings shall conform to Material Specification SD-55.

3. Handling and Storage

Pipe shall be delivered to the site and handled by means that provide adequate support to the pipe. Plastic pipe shall be protected from bending, impact, abrasion, and cutting damage. Manufacturer's recommendations must be followed. Special care shall be taken to avoid impact damage below 40^{o}F temperature. Pipe that is not ultraviolet resistant must not be exposed to sunlight for more than 15 days.

4. Joints and Connections

All joints and connections shall be made to carry design flows without significant pressure loss and to withstand the maximum design working pressure without leakage. Manufacturer's recommendations must be followed.

Dissimilar metals must not be in contact with each other. Steel or other metals subject to corrosion must be protected from corrosion using high quality materials.

5. Trench Construction

Except as shown on the drawings, pipe trenches shall be not wider than 30 inches.

Where rocks or other material that may damage the pipe is encountered, the trench bottom shall be excavated at least four inches below pipe grade and backfilled with bedding material consisting of sand or fine-grained soil.

6. Thrust Blocks

Thrust blocks must be formed against solid, compact earth. Thrust blocks shall consist of filling the space between the pipe and trench wall with concrete to the top of the pipe and to the dimensions shown on the drawings.

7. Placement

Small holes shall be excavated in bedding material under pipe bells, fittings, and appurtenances as needed to assure the pipeline is uniformly supported on bedding at line and grade throughout its entire length. Blocking or mounding beneath the pipeline to bring it to design grade is not permitted. Care shall be taken to prevent distortion or damage and to exclude foreign material from entering the pipeline.

8. Testing

The pipeline shall be completely tested for two hours at design pressure for pressure, leakage, and proper functioning. Lines must be slowly filled to avoid damage.

Conditions requiring repair and retest include excessive water hammer, continuing unsteady delivery of water, damage to the pipe, detrimental discharge from control valves, visible leaks, and/or loss of more than one-half gallon of water per hour per inch diameter per mile of pipe.

9. Backfill

All backfill recommendations of the pipe manufacturer shall be met. Vehicles or construction equipment shall not cross the pipe until earth cover over the pipe exceeds two feet.

Initial backfill to six inches above top of pipe is required. Except as otherwise specified, earth haunching and initial backfill shall consist of soil that is free of rocks, hard clods, or other objects more than one inch in diameter. Except where the pipe trench is precision excavated with pipe fitting bottom and with trench

width not more than 110 percent of the pipe diameter, earth fill shall be worked and compacted under the haunches of the pipe to provide continuous support in layers not more than six inches thick. Care shall be taken to insure the pipe is not deformed, damaged, or displaced.

Final backfill shall consist of remaining backfill from top of initial backfill to ground surface, including mounding for settlement. Final backfill within two feet of the pipe shall be free of debris, rocks or other objects three inches nominal diameter or larger. Final backfill shall be placed in approximately uniform, void free, compacted layers.

10. Certification and Guarantee

The installing contractor shall certify that his or her installation complies with this specification. The contractor shall furnish the installation owner a one-year written guarantee protecting the installation from defective materials and construction. Material manufacturers and pipe markings must also be supplied to the owner in writing.

PLASTIC PIPELINE (STOCKWATER AND/OR DOMESTIC) (SD-20A) CONSTRUCTION SPECIFICATION

1. Scope

The work consists of furnishing and installing Poly-vinyl Chloride (PVC), Polyethylene (PE), High Density Polyethylene (HDPE), and Acrylonitrile-Butadine-Styrene (ABS) plastic pipe complete with fittings and appurtenances, as shown on the drawings.

2. Materials

Plastic pipe and fittings shall conform to Material Specification SD-55.

3. Handling and Storage

Pipe shall be delivered to the site and handled by means that provide adequate support to the pipe. Plastic pipe shall be protected from bending, impact, abrasion, and cutting damage. Manufacturer's recommendations must be followed. Special care shall be taken to avoid impact damage below 40^{o}F temperature. Pipe that is not ultraviolet resistant must not be exposed to sunlight for more than 15 days.

4. Joints and Connections

All joints and connections shall be made to carry design flows without significant pressure loss and to withstand the maximum design working pressure without leakage. Manufacturer's recommendations must be followed.

Dissimilar metals must not be in contact with each other. Steel or other metals subject to corrosion must be protected from corrosion using high quality materials.

5. Trench Construction

Except as shown on the drawings, pipe trenches shall be not wider than 30 inches.

Where trench bottoms contain rocks or other material that may contact and damage the pipe, the trench bottom shall be excavated at least four inches below pipe grade and backfilled with bedding material consisting of sand or fine-grained soil.

Pipelines may be installed by "plow-in" where soils are suitable and rocks will not damage the pipe system.

6. Thrust Blocks

Except as otherwise specified, for pipelines greater than 1 1/2 inch diameter, thrust control shall be provided at all elbows greater than 45^{o}, all tee connections, and at any location of potential thrust damage.

Thrust blocks must be formed against solid, compact earth. Except as otherwise shown on the drawings, thrust blocks shall consist of filling the space between the pipe and trench wall with concrete to the top of the pipe and for a distance of one foot along the pipe in each direction from center of the thrust.

7. Placement

Pipe that is not connected with flexible "slip-joint" connections, must be installed in a "snake-like" position. The pipe shall be allowed to come to within a few degrees of subsoil temperature before backfilling or being connected to other facilities.

For pipe over four inches diameter, small holes shall be excavated in bedding material under pipe bells, fittings, and appurtenances as needed to assure the pipeline is uniformly supported on bedding at line and grade throughout its entire length. Blocking or mounding beneath the pipeline to bring it to design grade is not permitted. Care shall be taken to prevent distortion or damage and to exclude foreign material from entering the pipeline.

8. Testing

The pipeline shall be completely tested for two hours at design pressure (but not less than 10 feet of head) for pressure, leakage, and proper functioning. Lines must be slowly filled (to avoid damage) and flushed clean.

Conditions requiring repair and retest include excessive water hammer, continuing unsteady delivery of water, damage to the pipe, detrimental discharge from control valves, visible leaks, and/or loss of more than one-half gallon of water per hour per inch diameter per mile of pipe.

9. Backfill

All backfill recommendations of the pipe manufacturer shall be met. Vehicles or construction equipment shall not cross the pipe until earth cover over the pipe exceeds two feet.

Initial backfill to six inches above top of pipe is required. Except as otherwise specified, earth haunching and initial backfill shall consist of soil that is free of rocks, hard clods, or other objects more than one inch in diameter. Except where the pipe trench is precision excavated with pipe fitting bottom and with trench width not more than 110 percent of the pipe diameter, earth fill shall be worked and compacted under the haunches of the pipe to provide continuous support in layers not more than six inches thick. Care shall be taken to insure the pipe is not deformed, damaged, or displaced.

Final backfill shall consist of remaining backfill from top of initial backfill to ground surface, including mounding for settlement. Final backfill within two feet of the pipe shall be free of debris, rocks or other objects three inches nominal diameter or larger. Final backfill shall be placed in approximately uniform, void free, compacted layers.

10. Potable Water Pipelines

All equipment and pipelines used for water for human consumption shall meet all requirements (including shock chlorinating) of the South Dakota Department of Health. Manufacturer's recommendations must be followed.

11. Certification and Guarantee

The installing contractor shall certify that his or her installation complies with this specification. The contractor shall furnish the installation owner a one-year written guarantee protecting the installation from defective materials and construction. Material manufacturers and pipe markings must also be supplied to the owner in writing.

PLASTIC PIPELINE (STOCKWATER AND/OR DOMESTIC) (SD-20RC) CONSTRUCTION SPECIFICATION

1. Scope

The work consists of furnishing and installing plastic pipe, complete with fittings and appurtenances.

2. Materials

The pipe and fittings shall be free of visible cracks, holes, foreign inclusions, or other defects, and shall have dimensions measured as prescribed in ASTM D2122. Joints and fittings shall be as described in the pipe AWWA or ASTM specification and shall be compatible with and have pressure ratings at least equal to the specified pipe. Rubber gaskets for pipe joints shall conform to ASTM F477 Elastomeric Seals (Gaskets for Joining Plastic Pipe). Except as otherwise specified, pipe must conform to the following specifications. Spigot ends of the pipe must be marked with depth markers.

Poly vinyl chloride (PVC) Pipe

Plastic pipe - Schedule 40, 80, or 120 ..... ASTM D1785 or D2466
Pressure rated pipe - SDR Series ..... AWWA C900 or ASTM D2241
Plastic drain, waste, and vent pipe and fittings ..... ASTM D2665

Polyethylene (PE) pipe

Schedule 40 ..... ASTM D2104
SIDR-PR based on controlled inside diameter ..... ASTM D2239
Schedules 40 and 80 based on outside diameter ..... ASTM D2447
SDR-PR based on controlled outside diameter ..... ASTM D3035

Acrylonitrile-butadine-styrene (ABS) pipe

Plastic pipe, schedules 40 and 80 ..... ASTM D1527
Plastic pipe, SDR-PR ..... ASTM D2282

3. Potable use pipeline

Pipelines specified for use to carry potable water shall meet requirements of the National Sanitation Foundation (NSF). The pipe must be NSF marked.

All equipment and pipelines used for water for human consumption shall meet all requirements (including shock chlorination) of the South Dakota Department of Health. Manufacturer's recommendations must be followed

4. Joints and Connections

All joints and connections shall be made to carry design flows without significant pressure loss and to withstand the maximum design working pressure without leakage. Manufacturer's recommendations must be followed.

Dissimilar metals must not be in contact with each other. Steel or other metals subject to corrosion must be protected from corrosion using high quality materials.

5. Trench Construction

Where trench bottoms contain rocks or other material that may contact and damage the pipe, the trench bottom shall be excavated at least four inches below pipe grade and backfilled with bedding material consisting of sand or fine-grained soil.

Pipelines may be installed by "plow-in" where soils are suitable and rocks will not damage the pipe.

6. Thrust Blocks

Except as otherwise specified, for pipelines greater than 1 1/2 inch diameter, thrust control shall be provided at all elbows greater than 45^{o}, all tee connections, and any location of potential thrust damage. Thrust blocks shall consist of filling the space between the pipe and trench wall with concrete to the top of the pipe and for a distance of one foot along the pipe in each direction from center of the thrust, or by equally effective and durable thrust control methods.

7. Placement

Pipe that is not connected with flexible "slip-joint" connections, must be installed in a "snake-like" position. The pipe shall be allowed to come to within a few degrees of subsoil temperature before backfilling or being connected to other facilities.

8. Backfill

All backfill recommendations of the pipe manufacturer shall be met. The initial six inches of backfill shall be free of rocks, or other hard objects larger than one inch in diameter. The remainder of the backfill must placed in layers that will fill the trench without voids. Mound soil over the trench to allow for settlement.

10. Certification and Guarantee

The installing contractor shall certify that his or her installation complies with this specification. The contractor shall furnish the installation owner a one-year written guarantee protecting the installation from defective materials and construction.

PVC DRAIN FOR SEDIMENT BASIN (CNMS) (SD-19)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of furnishing and installing polyvinyl chloride (PVC) plastic pipe , fittings and appurtenances as shown on the drawings. This specification covers sediment basin drains. It is not applicable to water supply, sewer, or drain lines.

2. Material

Pipe shall have a minimum 160 PSI pressure rating, shall meet ASTM D1785 or D2241, and shall be defect free. Pipe compound shall meet ASTM D1784, Class 12454-B.

Fittings and appurtenances shall be made of the same material as the pipe, and be designed for use with the pipe at a minimum pressure rating of 160 PSI, except as otherwise specified.

Solvent cement for pipe joints shall meet ASTM D2564.

Rubber gasket joints shall conform to ASTM D3139.

3. Trench Construction

The trench bottom must provide uniform support for the pipe at specified lines and grades. Clods, rocks and other hard objects that may contact the pipe must be removed. Where rocks and other hard objects cannot be completely removed, the trench bottom must be undercut four inches minimum and backfilled to grade with compacted fine-grained soil.

4. Pipe Placement

Pipe must be installed to specified lines and grades without blocking, distortion or damage. The pipe must be uniformly supported on firm stable soil (or other specified bedding) over its entire length.

5. Backfill

All backfill recommendations of the pipe manufacturer shall be met. Vehicles or construction equipment shall not cross the pipe until earth cover over the pipe exceeds two feet.

Initial backfill to six inches above top of pipe is required. Except as otherwise specified, earth haunching and initial backfill shall consist of soil that is free of rocks, hard clods, or other objects more than one inch in diameter. Earth fill shall be worked and compacted under the haunches of the pipe to provide continuous support in layers not more than six inches thick. Care shall be taken to insure the pipe is not deformed, damaged, or displaced.

Final backfill shall consist of remaining backfill from top of initial backfill to ground surface, including mounding for settlement. Final backfill shall be free of debris, rocks or other objects three inches nominal diameter or larger. Final backfill shall be placed in approximately uniform, void free, compacted layers.

6. Protection from Ultraviolet Light

Portions of pipe that will be permanently exposed to sunlight must be primed with PVC solvent and painted with two coats of high quality exterior latex paint.

7. Measurement and Payment

The quantity of each pipe item will be measured to the nearest foot by measurement of laid length along invert centerline. Payment for each pipe item will be made at the contract unit price. Such payment will constitute full compensation for furnishing, transporting, and installing the pipe complete in place.

PVC DRAIN FOR SEDIMENT BASIN (CNMS) (SD-19)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of furnishing and installing polyvinyl chloride (PVC) plastic pipe , fittings and appurtenances as shown on the drawings. This specification covers sediment basin drains. It is not applicable to water supply, sewer, or drain lines.

2. Material

Pipe shall have a minimum 160 PSI pressure rating, shall meet ASTM D1785 or D2241, and shall be defect free. Pipe compound shall meet ASTM D1784, Class 12454-B.

Fittings and appurtenances shall be made of the same material as the pipe, and be designed for use with the pipe at a minimum pressure rating of 160 PSI, except as otherwise specified.

Solvent cement for pipe joints shall meet ASTM D2564.

Rubber gasket joints shall conform to ASTM D3139.

3. Trench Construction

The trench bottom must provide uniform support for the pipe at specified lines and grades. Clods, rocks and other hard objects that may contact the pipe must be removed. Where rocks and other hard objects cannot be completely removed, the trench bottom must be undercut four inches minimum and backfilled to grade with compacted fine-grained soil.

4. Pipe Placement

Pipe must be installed to specified lines and grades without blocking, distortion, or damage. The pipe must be uniformly supported on firm stable soil (or other specified bedding) over its entire length.

5. Backfill

All backfill recommendations of the pipe manufacturer shall be met. Vehicles or construction equipment shall not cross the pipe until earth cover over the pipe exceeds two feet.

Initial backfill to six inches above top of pipe is required. Except as otherwise specified, earth haunching and initial backfill shall consist of soil that is free of rocks, hard clods, or other objects more than one inch in diameter. Earth fill shall be worked and compacted under the haunches of the pipe to provide continuous support in layers not more than six inches thick. Care shall be taken to insure the pipe is not deformed, damaged, or displaced.

Final backfill shall consist of remaining backfill from top of initial backfill to ground surface, including mounding for settlement. Final backfill shall be free of debris, rocks, or other objects three inches nominal diameter or larger. Final backfill shall be placed in approximately uniform, void free, compacted layers.

6. Protection from Ultraviolet Light

Portions of pipe that will be permanently exposed to sunlight must be primed with PVC solvent and painted with two coats of high-quality exterior latex paint.

7. Measurement and Payment

The quantity of each pipe item will be measured to the nearest foot by measurement of laid length along invert centerline. Payment for each pipe item will be made at the contract unit price. Such payment will constitute full compensation for furnishing, transporting, and installing the pipe complete in place.

ROCK RIPRAP AND BEDDING (SD-8)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of furnishing and installing loose rock riprap and blankets, including filter layers, bedding, or geotextiles as shown on the drawings.

2. Materials

Rock Riprap - Individual rock fragments shall be dense, hard, durable, and free from cracks, seams, and other defects conductive to accelerated weathering. Except as otherwise specified, rock fragments shall be angular or sub-rounded. The least dimension of an individual rock fragment shall be not less than one-third the greatest dimension of the fragment. ASTN D4992 provides guidance on selecting rock from a source.

Rock that fails to meet the above requirements will be accepted only if similar rock from the same source has been demonstrated to be sound after three years of exposure to conditions similar to conditions where the riprap is to be placed.

The rock shall conform to the grading limits shown on the drawings. Sand, rock fines, and dirt shall be less than five percent of the total weight of the riprap.

Sand, Gravel Filter - Filter aggregates shall be sand, gravel, crushed stone or mixtures thereof. Aggregates shall be composed of clean, hard, durable mineral particles free of organic matter, clay balls, soft particles, or other substances that would interfere with free-draining properties of the aggregates.

Not more than 5 percent of the material of the material may be limestone, and not more than 15 percent may be flat, elongated particles.

Except as otherwise shown on the drawings, the aggregate shall meet the following gradation requirements after placement.

Filter Aggregate Size	% Finer by Weight
3"	100
1"	90 to 100
No. 4	50 to 85
No. 50	10 to 40
No. 200	0 to 5

Geotextile - Geotextiles shall conform to (NEH) Material Specification 592-Geotextile. The geotextile fabric shall be protected from moisture, dust, dirt, debris, and ultraviolet light prior to installation.

3. Subgrade Preparation

Subgrade surfaces on which riprap, bedding, or geotextile will be placed shall be cut or filled to the lines and grades shown on the drawings. When fill to subgrade lines is required, it shall consist of approved materials and shall conform to the requirements of the specified class of fill.

Riprap, bedding or geotextile shall not be placed until the foundation preparation is completed and the surfaces have been inspected and approved by the NRCS inspector.

4. Equipment-placed Rock Riprap

Rock riprap shall be placed by equipment on the surface and to the depth specified. It shall be installed to the full course thickness in one operation and in a manner as to avoid serious displacement of the underlying material. The rock shall be delivered and placed in a manner that ensures the riprap in place is reasonably homogenous with the larger rocks uniformly distributed and firmly in contact one to another and with the smaller rocks and spalls filling the voids between the larger rocks. Some hand placing may be required to provide a neat and uniform surface.

Rock riprap shall be placed in a manner to prevent damage to structures. Hand placing is required as necessary to prevent damage to new and existing structures.

5. Hand-placed Rock Riprap

The rock riprap shall be placed on the surface and to the depth specified. It shall be securely bedded with the larger rocks firmly in contact one to another without bridging. Spaces between the larger rocks shall be filled with smaller rocks and spalls. Smaller rocks shall not be grouped as a substitute for larger rocks. Flat slab rock shall be laid on its vertical edge except where it is laid like paving stone and the thickness of the rock equals the specified depth of the riprap course.

6. Filters, Bedding, or Geotextiles

When the drawings specify filters, bedding, or geotextile beneath the rock riprap, the designated material shall be placed on the prepared subgrade surface as specified. Compaction of filter or bedding aggregate is not required, but the surface of such material shall be furnished reasonably smooth and free of mounds, dips, or windrows.

Where drawings require geotextiles beneath riprap, the geotextile shall be laid on the prepared subgrade surfaces with no folds or ripples. The geotextile fabric should be in direct contact with the subgrade surface. Except as otherwise specified, the fabric should be placed parallel to stream alignments and perpendicular to lake shorelines. Except as otherwise specified, the geotextile splices shall overlap at least 18 inches, or shall be sewn following the geotextile manufacturer's recommendations. Anchoring pins shall be placed as recommended by the geotextile manufacturer except as otherwise specified.

ROCK RIPRAP (SDDOT SIZE A) AND BEDDING (SD-8A) CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of furnishing and installing loose rock riprap and blankets, including filter layers, bedding, or geotextiles as shown on the drawings.

2. Materials

Rock Riprap - Individual rock fragments shall be dense, hard, durable, and free from cracks, seams, and other defects conductive to accelerated weathering. Except as otherwise specified, rock fragments shall be angular or sub-rounded. The least dimension of an individual rock fragment shall be not less than one-third the greatest dimension of the fragment. ASTN D4992 provides guidance on selecting rock from a source.

Rock that fails to meet the above requirements will be accepted only if similar rock from the same source has been demonstrated to be sound after three years of exposure to conditions similar to conditions where the riprap is to be placed.

The rock shall conform to the grading limits listed below. Sand, rock fines, and dirt shall be less than five percent of the total weight of the riprap.

Rock Size (pounds) (SDDOT Size A)	Percent Smaller Than
200	100
75	50
5	15

Sand, Gravel Filter - Filter aggregates shall be sand, gravel, crushed stone, or mixtures thereof. Aggregates shall be composed of clean, hard, durable mineral particles, free of organic matter, clay balls, soft particles or other substances that would interfere with free-draining properties of the aggregates.

Not more than 5 percent of the material of the material may be limestone, and not more than 15 percent may be flat, elongated particles.

Except as otherwise shown on the drawings, the aggregate shall meet the following gradation requirements after placement.

Filter Aggregate Size	% Finer by Weight
3"	100
1"	90 to 100
No. 4	50 to 85
No. 50	10 to 40
No. 200	0 to 5

Geotextile - Geotextiles shall conform to National Engineering Handbook (NEH) Material Specification 592-Geotextile. The geotextile fabric shall be protected from moisture, dust, dirt, debris, and ultraviolet light prior to installation.

3. Subgrade Preparation

Subgrade surfaces on which riprap, bedding, or geotextile will be placed shall be cut or filled to the lines and grades shown on the drawings. When fill to subgrade lines is required, it shall consist of approved materials and shall conform to the requirements of the specified class of fill.

Riprap, bedding, or geotextile shall not be placed until the foundation preparation is completed and the surfaces have been inspected and approved by the NRCS inspector.

4. Equipment-placed Rock Riprap

Rock riprap shall be placed by equipment on the surface and to the depth specified. It shall be installed to the full course thickness in one operation and in a manner as to avoid serious displacement of the underlying material. The rock shall be delivered and placed in a manner that ensures the riprap in place is reasonably homogenous with the larger rocks uniformly distributed and firmly in contact one to another and

with the smaller rocks and spalls filling the voids between the larger rocks. Some hand placing may be required to provide a neat and uniform surface.

Rock riprap shall be placed in a manner to prevent damage to structures. Hand placing is required as necessary to prevent damage to new and existing structures.

5. Hand-placed Rock Riprap

The rock riprap shall be placed on the surface and to the depth specified. It shall be securely bedded with the larger rocks firmly in contact one to another without bridging. Spaces between the larger rocks shall be filled with smaller rocks and spalls. Smaller rocks shall not be grouped as a substitute for larger rocks. Flat slab rock shall be laid on its vertical edge except where it is laid like paving stone and the thickness of the rock equals the specified depth of the riprap course.

6. Filters, Bedding, or Geotextiles

When the drawings specify filters, bedding, or geotextile beneath the rock riprap, the designated material shall be placed on the prepared subgrade surface as specified. Compaction of filter or bedding aggregate is not required, but the surface of such material shall be furnished reasonably smooth and free of mounds, dips, or windrows.

Where drawings require geotextiles beneath riprap, the geotextile shall be laid on the prepared subgrade surfaces with no folds or ripples. The geotextile fabric should be in direct contact with the subgrade surface. Except as otherwise specified, the fabric should be placed parallel to stream alignments and perpendicular to lake shorelines. Except as otherwise specified, the geotextile splices shall overlap at least 18 inches, or shall be sewn following the geotextile manufacturer's recommendations. Anchoring pins shall be placed as recommended by the geotextile manufacturer except as otherwise specified.

ROCK RIPRAP (SDDOT SIZE B) AND BEDDING (SD-8B) CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of furnishing and installing loose rock riprap and blankets, including filter layers, bedding, or geotextiles as shown on the drawings.

2. Materials

Rock Riprap - Individual rock fragments shall be dense, hard, durable, and free from cracks, seams, and other defects conductive to accelerated weathering. Except as otherwise specified, rock fragments shall be angular or sub-rounded. The least dimension of an individual rock fragment shall be not less than one-third the greatest dimension of the fragment. ASTN D4992 provides guidance on selecting rock from a source.

Rock that fails to meet the above requirements will be accepted only if similar rock from the same source has been demonstrated to be sound after three years of exposure to conditions similar to conditions where the riprap is to be placed.

The rock shall conform to the grading limits listed below. Sand, rock fines, and dirt shall be less than five percent of the total weight of the riprap.

Rock Size (pounds) (SDDOT Size B)	Percent Smaller Than
500	100
200	50
5	15

Sand, Gravel Filter - Filter aggregates shall be sand, gravel, crushed stone or mixtures thereof. Aggregates shall be composed of clean, hard, durable mineral particles free of organic matter, clay balls, soft particles or other substances that would interfere with free-draining properties of the aggregates.

Not more than 5 percent of the material of the material may be limestone, and not more than 15 percent may be flat, elongated particles.

Except as otherwise shown on the drawings, the aggregate shall meet the following gradation requirements after placement.

Filter Aggregate Size	Percent Finer by Weight
3"	100
1"	90 to 100
No. 4	50 to 85
No. 50	10 to 40
No. 200	0 to 5

Geotextile - Geotextiles shall conform to National Engineering Handbook (NEH) Material Specification 592-Geotextile. The geotextile fabric shall be protected from moisture, dust, dirt, debris, and ultraviolet light prior to installation.

3. Subgrade Preparation

Subgrade surfaces on which riprap, bedding, or geotextile will be placed shall be cut or filled to the lines and grades shown on the drawings. When fill to subgrade lines is required, it shall consist of approved materials and shall conform to the requirements of the specified class of fill.

Riprap, bedding, or geotextile shall not be placed until the foundation preparation is completed and the surfaces have been inspected and approved by the NRCS inspector.

4. Equipment-placed Rock Riprap

Rock riprap shall be placed by equipment on the surface and to the depth specified. It shall be installed to the full course thickness in one operation and in a manner as to avoid serious displacement of the underlying material. The rock shall be delivered and placed in a manner that ensures the riprap in place is reasonably homogenous with the larger rocks uniformly distributed and firmly in contact one to another and

with the smaller rocks and spalls filling the voids between the larger rocks. Some hand placing may be required to provide a neat and uniform surface.

Rock riprap shall be placed in a manner to prevent damage to structures. Hand placing is required as necessary to prevent damage to new and existing structures.

5. Hand-placed Rock Riprap

The rock riprap shall be placed on the surface and to the depth specified. It shall be securely bedded with the larger rocks firmly in contact one to another without bridging. Spaces between the larger rocks shall be filled with smaller rocks and spalls. Smaller rocks shall not be grouped as a substitute for larger rocks. Flat slab rock shall be laid on its vertical edge except where it is laid like paving stone and the thickness of the rock equals the specified depth of the riprap course.

6. Filters, Bedding, or Geotextiles

When the drawings specify filters, bedding, or geotextile beneath the rock riprap, the designated material shall be placed on the prepared subgrade surface as specified. Compaction of filter or bedding aggregate is not required, but the surface of such material shall be furnished reasonably smooth and free of mounds, dips, or windrows.

Where drawings require geotextiles beneath riprap, the geotextile shall be laid on the prepared subgrade surfaces with no folds or ripples. The geotextile fabric should be in direct contact with the subgrade surface. Except as otherwise specified, the fabric should be placed parallel to stream alignments and perpendicular to lake shorelines. Except as otherwise specified, the geotextile splices shall overlap at least 18 inches, or shall be sewn following the geotextile manufacturer's recommendations. Anchoring pins shall be placed as recommended by the geotextile manufacturer except as otherwise specified.

SEEDING (SD-28)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of furnishing all labor, equipment, and materials needed for seeding the areas shown on the drawings.

2. General

Seeding and related operations shall be performed in the following time period.

Dates: _____

_____

3. Fertilizer

Fertilizer shall be uniformly applied commercial liquid or dry fertilizer conforming to South Dakota laws and regulations. Fertilizer shall be supplied and applied as follows.

Types and rates: _____

_____

_____

4. Seed

Seed requirements and seeding rates are listed below. Documentation must be provided showing the seed meets current South Dakota laws and regulations. The seed must be planted within one year of its latest germination test.

_____

_____

5. Seedbed Preparation

The area to be seeded shall be made reasonably smooth and firm. Ditches shall be filled to conform to design lines and grades before seedbed preparation is begun. Prior to seeding, required fertilizer shall be applied and mixed with the soil surface to a depth of three inches. The contractor shall suspend operations when the soil is too wet.

6. Cover and/or Nurse Crops

When specified, cover and/or nurse crops shall be seeded as follows:

_____

_____

_____

_____

7. Sowing Seed

Except as otherwise specified, seeding shall be performed immediately after seedbed preparation. Seeding shall be drilled or broadcast and incorporated in a manner that will achieve uniform distribution of seed placed at appropriate soil depth.

When seeding waterways or similar water flow areas, machinery operations must be performed in a direction that is not parallel to water flow (use figure 8, serpentine, etc.).

8. Mulching

Except as otherwise specified, required mulching must be performed as soon as possible after seeding. Mulch shall be applied uniformly as follows.

SODDING (SD-29)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of furnishing and laying sod as shown on the drawings.

2. General

Sodding and related operations shall be performed in the following time period.

Dates: _____

_____

3. Fertilizer

Fertilizer shall be uniformly applied commercial liquid or dry fertilizer conforming to South Dakota laws and regulations. Fertilizer shall be supplied and applied as follows.

Types and rates: _____

_____

_____

4. Sod

Sod shall consist of specified uniform strips or blocks of adapted species.

5. Sod Bed Preparation

The surface to be sodded shall be reasonably smooth and free from stones, roots, and other debris, and shall conform to the lines and grades shown on the drawings.

Prior to laying sod, fertilizer shall be applied and mixed with the soil surface to a depth of three inches.

Sod must be laid on moist soil. Add water as necessary to maintain the moist surface.

6. Sod Placement

Sod shall be carefully placed, tamped, and anchored as specified.

7. Sod Establishment

Sod shall be watered as needed to maintain viability for the following time period:

_____

STEEL PIPELINE (SD-21)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of furnishing and installing steel pipe complete with lining, coating, fittings, and appurtenances.

2. Material

Except as otherwise specified, steel pipe and fittings shall conform to Material Specification SD-52.

Unless otherwise specified, all special fittings and appurtenances shall be of the same material as the pipe.

3. Handling Pipe

Pipe shall be stored and handled by methods that will protect the pipe and coating from damage.

4. Placement of Buried Pipelines

Pipe shall be installed to the lines and grades shown on the drawings. The pipe shall be firmly and uniformly bedded to the depth and in the manner specified on the drawings. An ample bell hole working area may be left at pipe joints to perform welding, coating, and other related activities. The bell hole area shall be bedded, as specified before backfill operations.

Where trenches are excavated in rock or other hard material that might damage the pipe or coating, trenches shall be excavated at least three inches deeper than line and grade and backfilled to grade with sand or fine earth. At least three inches of soil or sand shall separate pipe from objectionable material.

Backfill shall be placed to final grades (including mounding for settlement) shown on the drawings. Backfill within two feet of the pipe shall be free of debris, rocks, or other objects three inches nominal diameter or larger. Final backfill shall be placed in approximately uniform, void free, compacted layers.

5. Above Ground Pipelines

Above ground supports and pipelines shall be constructed to the lines and grades and as shown on the drawings.

6. Joints and Connections

Pipe joints shall conform to the details shown on the drawings and shall be sound and watertight at specified pressures. Gasket joints and other high pipe-to-pipe electrical resistance joints shall be electrically bridged with a welded, brazed, or soldered copper wire not smaller than No. 6 AWG.

Welded joints shall conform to the welding procedures and requirements of AWWA Standard C206. Field welding shall avoid burning pipe coatings except in the immediate vicinity of the weld. Welded field joints shall be single welded butt joints or lap welded slip joints as shown on the drawings.

Bell and spigot joint dimensions and installed seating shall conform to manufacturer's recommendations. The pipe shall be laid with the bell end upstream. Installed and seated gaskets must be in their annular recess, and must provide a positive seal. Installed joints with "fish-mouthed" gaskets must be taken apart and reseated with a new gasket. Rubber gaskets shall meet AWWA C200.

Mechanical couplings - Pipe ends shall be free of dents, gouges, rust, and scale, and shall be machined to prevent displacing gaskets and ensure uniform end separation of the pipes. Gaskets shall be continuous rubber rings conforming to dimensions and tolerances recommended by the manufacturer. Coupling followers shall be drawn up evenly to ensure uniform pressure on the gasket. Grooved and shouldered joints shall meet AWWA C606.

Flanged joints - All steel ring flanges shall meet AWWA C207. Gaskets shall be either 1/16 to 1/8 inch thick neoprene cloth, or 1/16 inch thick red rubber. Gaskets used between flat flange surfaces shall cover the full flange face.

Fitting and coupling coating - Except as otherwise specified, compression couplings, mechanical couplings, and flanged couplings shall be coated with AWWA C203 coal tar enamel coating, or vinyl

coating as recommended by the manufacturer. All bolts shall be stainless steel or low alloy steel and shall be field coated with coal tar enamel or vinyl coating after installation.

7. Field lining, coating, wrapping, and repair

Except as otherwise specified, lining and wrapping of field joints or connections and repair of wrap or coating damage on pipe, couplings, fittings, and appurtenances shall be cleaned and covered with a coating equal to that specified for the pipe.

8. Pressure Testing

Underground pipelines shall be tested before backfill has been placed over the field joints. Above ground pipelines shall be tested (anytime) after they are ready for operation.

Before testing, all specified concrete anchors and thrust blocks shall have been in place at least three days, pipe ends shall be plugged, and backfill around pipe between joints shall be placed to prevent pipe movement.

The pipeline shall be flushed and cleaned and then slowly filled with water, taking care to bleed air and prevent water hammer. When the line is full, all valves shall be closed and the line brought up to maximum design working pressure for a period of two hours. All joints shall then be carefully inspected for leakage. Leaks shall be repaired and if necessary, the line shall be retested.

Testing shall demonstrate that all valves, vents, surge chambers, and other appurtenances function properly at design conditions. Objectionable surge, water hammer, unsteady delivery of water, damage to the pipeline, and detrimental discharge from control valves are evidence of malfunction.

9. Cathodic Protection

When specified, cathodic protection shall be provided and installed as shown on the drawings.

STEEL REINFORCEMENT (SD-13)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of furnishing and placing steel reinforcement for reinforced concrete or pneumatically applied mortar.

2. Materials

Steel reinforcement shall be free of flaky rust, oil, grease, paint, mill scale, or other deleterious matter.

Steel bar reinforcement (except as otherwise specified) shall be grade 40, 50, or 60 deformed bars conforming to one of the following specifications.

a. Deformed and Plain Billet-steel Bars for Concrete Reinforcement ASTM A615
b. Rail-steel Deformed and Plain Bars for Concrete Reinforcement ASTM A616 with S1 Supplement Requirements
c. Axle-steel Deformed and Plain Bars for Concrete Reinforcement ASTM A617

Dowels shall be plain round bars conforming to the above specifications.
Fabricated deformed steel bar mats for concrete reinforcement shall meet ASTM A184.
Plain steel welded wire fabric for concrete reinforcement shall meet ASTM A185.
Deformed steel welded wire fabric for concrete reinforcement shall meet ASTM A497.
Epoxy-coated steel bars for concrete reinforcement shall meet ASTM A775.

3. Cutting and Bending

Reinforcing bars may be shop or field cut and/or bent. All bends must be made without heating or otherwise weakening the bar. Shop bends must meet American Concrete Institute Standard 315. Bars with kinks, cracks, or improper bends will be rejected.

4. Splicing Bar Reinforcement

Except as otherwise specified, splices of reinforcing bars shall provide an overlap of at least 30 times the smaller bar diameter, but not less than 12 inches.

5. Splicing Welded Wire Fabric

Welded wire fabric shall be overlapped one full mesh (rectangle) not counting cut portions.

6. Placing

Reinforcing shall be accurately placed and secured in position to prevent its displacement during concrete placement. Tack welding of bars is not permitted. Dimensions shown on the plans indicating concrete cover are the clear distances from the concrete surface to the reinforcing steel.

Metal hangers, spacers, and ties shall be placed in a manner that they are not exposed in the finished concrete surface. The legs of metal chairs or side form spacers that may be exposed on any surface of slabs, walls, beams, or other concrete surfaces shall be a design that will not corrode at the concrete surface. Precast concrete chairs shall be clean and moist at the time of concrete placement.

On structures exceeding four cubic yard of concrete, concrete shall not be placed until the reinforcement has been inspected and approved by the NRCS inspector. For any size pour, inspection of reinforcement embedded in concrete may be performed by the NRCS inspector using radar or other inspection instruments.

STRIPPING (SD-4)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of removing topsoil and other undesirable materials from borrow areas and foundations of structures and earth fills.

2. General

Required stripping excavation depth will be the depth needed to expose subsoil reasonably free of roots and other perishable material. Excavated earth material suitable for fill shall be placed in earth fills as appropriate. Stripped material suitable for topsoil shall be stockpiled and placed over disturbed areas as shown on the drawings or as approved by the NRCS inspector. All waste material shall be disposed of as shown on the drawings or as approved by the NRCS inspector.

3. Foundation Stripping

Remove loose soil and extend stripping to a reasonably smooth surface in consolidated subsoil. Except as shown on the drawings, foundation slopes shall be excavated to one horizontal to one vertical or flatter.

4. Borrow Area Stripping

Borrow areas shall be stripped to expose material suitable for earth fill.

STRUCTURE REMOVAL (SD-3)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of the removal, salvage, and disposal of structures (including fences) from the designated areas.

2. Marking

Each structure or structure part to be removed will be as described on the drawings or marked by the NRCS inspector.

3. Removal

The extent and depth of required structural removal shall be as described on the drawings or shall be as designated by the NRCS inspector.

4. Salvage

Structures or structure parts designated to be salvaged shall be carefully removed and neatly placed in the specified or approved storage location. Salvaged structures that are capable of being disassembled shall be dismantled into individual members or sections. Such structures shall be neatly and systematically match marked with paint before disassembly. All connectors and other parts shall be marked to indicate their proper location within the structure and shall be fastened to the appropriate structural member or packed in suitable containers.

Material from fences designated to be salvaged shall be placed outside the work area on the fence owner's property. Fence wire shall be rolled into uniform rolls of suitable size and piled with other salvaged materials. Posts and rails shall be neatly stacked.

All salvaged materials shall remain the property of the owner unless otherwise specified.

5. Disposal of Refuse Materials

Refuse materials shall be disposed of by burning and/or burying at locations shown on the drawings or shall be disposed of by methods and at sites selected by the contractor and approved by the NRCS inspector. Materials to be buried shall be placed at least two feet below the surrounding ground line, and shall be covered by at least two feet of soil with the soil surface graded to drain.

The contractor is responsible for complying with all applicable laws and regulations and the payment of any and all fees that may result from disposal.

TERRACES (SD-26)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of excavation, shaping, grading, and earthfill required to construct the terraces shown on the drawings or as staked in the field.

2. Site Preparation

Excavation and fill areas shall be stripped to remove vegetation, trash, and other unsuitable materials prior to terrace construction. All existing dead furrows and gullies shall be filled before construction or the work shall be part of the construction. All existing terraces, fence rows, and other obstructions shall be removed as necessary to install the terraces as designed.

3. Fill Material

Earth material used in construction of earthfills shall be suitable material obtained from required excavations or designated borrow areas. Material for earth fills shall be free of frozen material, brush, roots one inch diameter or larger, sod, stones over six inches diameter, or other objectionable material.

4. Terrace Construction

a. Terraces shall be constructed at the locations and to the grades described in the design. Minimum constructed terrace cross sections shall be as staked in the field and described in the design.
b. When specified on the drawings, topsoil shall be stockpiled and spread over excavations and other areas to facilitate restoration of productivity.
c. Except as otherwise specified, tops of constructed terrace ridges shall be at design height plus 10 percent overfill for settlement. Terrace ridges must be compacted as much as possible by travel of construction machinery.
d. When full or partial end closures are specified, they shall be assumed a part of the terrace and must be built before the system is considered complete.
e. Cuts in ridges and fills in low areas may be required to maintain design alignment and grades.
f. Disturbed areas that are not to be farmed, including steep backslope terraces, shall be left reasonably smooth for seeding.

SALVAGING AND SPREADING TOPSOIL (SD-10)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of salvaging topsoil from borrow pits or other excavations and spreading it in the designated areas to the specified depths.

2. Quality of Topsoil

Topsoil shall consist of friable soil reasonably free of grass, roots, weeds, sticks, stones, or other foreign materials.

3. Excavation

Topsoil shall be removed after clearing, grubbing and removing vegetation and shall be stockpiled. Objectionable materials shall be removed and buried, or disposed of, at locations approved by the NRCS inspector.

4. Spreading

Spreading shall not be done when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the work. Surfaces to be covered shall be lightly scarified just prior to the spreading operation.

All earth fills not to be submerged shall be covered with topsoil to a depth of 6 to 18 inches measured perpendicular to the surface of the fill and placed to the neat lines shown on the drawings.

After placement is completed, the topsoil surface shall be left in a condition that will permit seeding equipment to be operated without excessive smoothing.

WELL (SD-32)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of furnishing and installing all materials and performing all operations and testing necessary for the construction of the specified wells in compliance with South Dakota laws and regulations. It does not include tanks, pumps, electrical equipment, or related piping installed in or near the well.

2. South Dakota Laws and Regulations and Well Driller Qualifications

Well construction, testing, and disinfection shall meet South Dakota state and local laws and regulations.

The work must be performed by a well driller licensed in South Dakota.

3. Materials

Casing materials general requirements - Casing materials must be nonpolluting, durable, and designed for the application (including well depths and water temperatures and pressures). Maximum depth for well casings must be based on critical collapse pressure calculated by the Cleindeinst Equation in ASTM F480 Appendix X2.

Except as otherwise specified, casing materials may be steel, copper, plastic, concrete, or similar nonpolluting materials of equivalent strength and durability. All materials must be new or equal. Casing diameter must be as large as needed to fully serve the purpose. Minimum casing diameter shall be one and a half inches. Couplings and fittings must have strength equal to the casing.

Plastic pipe - shall meet ASTM F480. Maximum allowable depth of installation for standard dimension ratio (SDR) polyvinylchloride (PVC), acrylonitrile-butadiene-styrene (ABS), and styrene-rubber (SR) pipes are as follows. Depths shown are for water temperatures below 100°F.

SDR	Plastic Material			
	PVC		ABS	SR
	Modulus of Elasticity (E)			
	400,000	320,000	250,000	300,000
	depth, feet	depth, feet	depth, feet	depth, feet
13.5	985	785	615	735
17	475	380	295	355
21	245	200	150	185
26	130	100	80	95
32.5	65	50	40	50

Depths for other modulus of elasticity materials shall be as shown in NRCS Practice Standard: Well 642.

Maximum allowable depth for solid PVC Schedule 40, 80, and 120 pipe with 40,000 lb/in.^{2} modulus of elasticity are as follows. Depths shown are for water temperatures below 100°F.

Nominal diameter, inch	Schedule 40		Schedule 80		Schedule 120	
	SDR	Depth, feet	SDR	Depth, feet	SDR	Depth, feet
2	15.4	650	10.9	19,60	9.5	3,070
2 1/2	14.2	840	10.4	2,260	9.6	2,970
3	16.2	550	11.7	1,150	10.0	2,580
3 1/2	17.7	420	12.6	1,220	10.2	2,410
4	19.0	340	13.4	1,010	10.3	2,330
5	21.6	230	14.8	740	11.1	1,830
6	23.7	170	15.3	660	11.8	1,510
8	26.8	450	17.3	450	12.0	1,430
10	29.5	90	18.1	390	12.8	1,160
12	31.4	15	18.6	360	12.8	1,160

Depths for other modulus of elasticity materials shall be as shown in NRCS Practice Standard, Water Well 642.

Reinforced Plastic Mortar (RPM) pipe - Maximum allowable depths for RPM pipe shall be as shown in NRCS Practice Standard, Water Well 642.

Other pipe materials shall meet requirements of South Dakota laws and regulations.

4. Installation

Installation shall meet requirements of South Dakota laws and regulations.

5. Records and Certification

A copy of the well log required under South Dakota law must be provided to NRCS.

The well installer must provide NRCS a completed and signed copy of form SD-ENG-51 Well (642) (Record of Installation).

WOOD FABRICATION AND INSTALLATION (SD-16)
CONSTRUCTION SPECIFICATION

1. Scope

The work shall consist of furnishing and constructing wood structures and wood parts of composite structures.

2. Plywood Material

Plywood and Oriented Strand Board (OSB) for use in above ground sheltered construction (buildings, etc.,) shall meet Product Standard PS-1 and shall conform to the requirements shown on the drawings.

Plywood for use in exposed above ground construction shall be exterior grade, meet Product Standard PS-1 and shall conform to the requirements shown on the drawings.

Treated plywood for use above ground shall meet Product Standard PS-1 and be pressure treated with waterborne preservatives (Arsenicals) to a retention level of at least 0.4 pounds per cubic foot except as shown on the drawings.

Treated plywood that is to be in permanent contact with water or the earth must meet Product Standard PS-1 and be pressure treated with waterborne preservatives (Arsenicals) to a retention level of 0.6 pounds per cubic foot, except as shown on the drawings.

3. Structural Timber and Lumber Material

All wood material shall be sound wood free from decay and disease damage, shall be straight, not cracked, and shall meet the requirements shown on the drawings. Structural timber and lumber shall be structural grade or better.

Unless otherwise specified, all timber and all nominal lumber sizes 2X10 or larger shall be pressure treated by one of the following preservatives:

Cresote

Pentachlorophenol

Waterborne Preservatives (Arsenicals) treated to 0.4 pounds per cubic foot retention

Unless otherwise specified, all nominal lumber sizes 2X8 or smaller shall be pressure treated using waterborne preservatives (Arsenicals). Wood for use above ground shall be treated to a retention level of at least 0.4 pounds per cubic foot. Wood for use in permanent contact with water or earth shall be treated to a retention level of at least 0.6 pounds per cubic foot.

4. Metal Hardware

Bolts, nuts, washers, rods, angle iron, and other metal hardware shall be an appropriate grade of steel, and if installed underground, shall be galvanized, or have equal corrosion protection.

5. Installation

All framing shall be true and exact. Timber and lumber shall be accurately cut and assembled to close fit. Nails and spikes shall be driven with just sufficient force to set the heads flush with the surface of the wood.

Bolt holes shall be drilled for snug fit. Holes for lag screws shall be bored with a bit not larger than the body of the screw at the base of the thread.

Washers shall be used in contact with all bolt heads and nuts that would otherwise be in contact with wood.